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STAR
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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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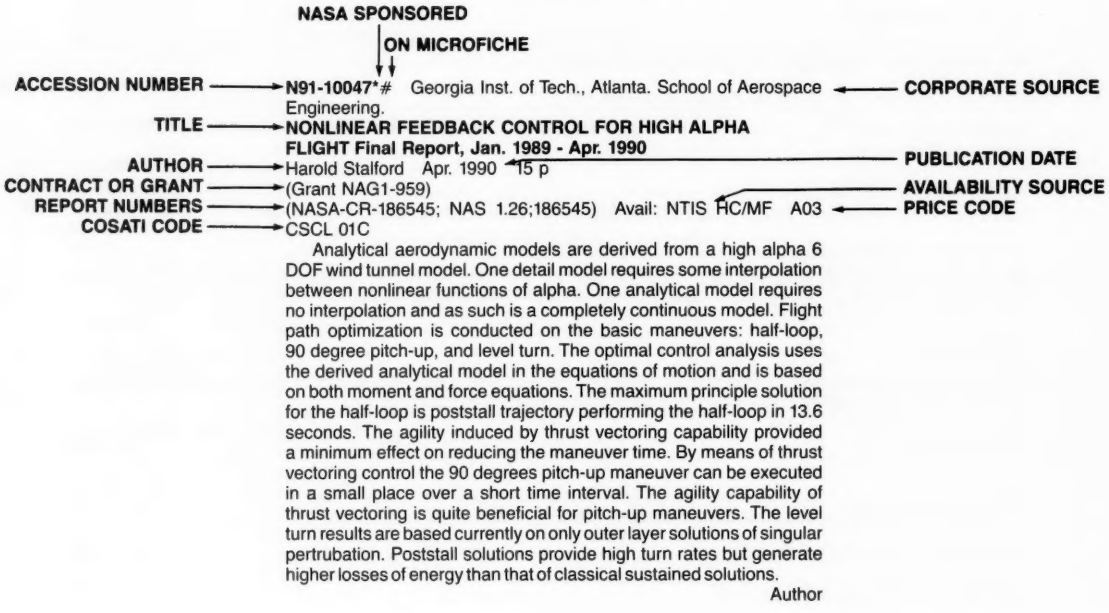
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ACCESSION NUMBER
N91-10047*# Georgia Inst. of Tech., Atlanta. School of Aerospace Engineering.
CORPORATE SOURCE
TITLE
NONLINEAR FEEDBACK CONTROL FOR HIGH ALPHA FLIGHT Final Report, Jan. 1989 - Apr. 1990
AUTHOR
Harold Stalford Apr. 1990 15 p
PUBLICATION DATE
CONTRACT OR GRANT
(Grant NAG1-959)
AVAILABILITY SOURCE
REPORT NUMBERS
(NASA-CR-186545; NAS 1.26;186545) Avail: NTIS HC/MF A03
PRICE CODE
COSATI CODE
CSCL 01C
Analytical aerodynamic models are derived from a high alpha 6 DOF wind tunnel model. One detail model requires some interpolation between nonlinear functions of alpha. One analytical model requires no interpolation and as such is a completely continuous model. Flight path optimization is conducted on the basic maneuvers: half-loop, 90 degree pitch-up, and level turn. The optimal control analysis uses the derived analytical model in the equations of motion and is based on both moment and force equations. The maximum principle solution for the half-loop is poststall trajectory performing the half-loop in 13.6 seconds. The agility induced by thrust vectoring capability provided a minimum effect on reducing the maneuver time. By means of thrust vectoring control the 90 degrees pitch-up maneuver can be executed in a small place over a short time interval. The agility capability of thrust vectoring is quite beneficial for pitch-up maneuvers. The level turn results are based currently on only outer layer solutions of singular pertrubation. Poststall solutions provide high turn rates but generate higher losses of energy than that of classical sustained solutions.
Author

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Scientific and Technical Aerospace Reports

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01 AERONAUTICS (GENERAL)

N91-30074# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Systems and Logistics.
A CASE STUDY OF MANNED STRATEGIC BOMBER ACQUISITION: THE B-70 VALKYRIE M.S. Thesis
Gary Beatovich Sep. 1990 113 p
(AD-A229545; AFIT/GSM/LSR/90S-2) Avail: NTIS HC/MF A06 CSCL 01/3

This research compiled a chronological history of the North American B-70 Valkyrie bomber program, from its beginnings to the rollout of the first prototype in May 1964. This history was analyzed for significant events, and those events analyzed for their causes and impacts. With this information, lessons were found which can be applicable to current or future bomber acquisitions. An initial literature review showed that this compiled history did not previously exist, and that existing literature contained theories which needed resolution. The analysis showed ICBM programs took priority over defense dollars in 1959, leading to the B-70's first cancellation. The following Administration determined there was no need for the air craft, either as a bomber or as a reconnaissance-strike vehicle. Events unrelated to strategic mission requirements played a significant role in Presidential and Congressional support of the program. Issues and theories found during the literature review were found to be inaccurate, and lessons applicable for today were cited and discussed. GRA

N91-30075# Executive Resource Associates, Inc., Arlington, VA.
GENERAL AVIATION PILOT AND AIRCRAFT ACTIVITY SURVEY Triannual Summary Report, 1990
1991 111 p Prepared in cooperation with Adsystech, Inc., Silver Spring, MD
(Contract DTFA01-88-Y-01026)
(AD-A236497) Avail: NTIS HC/MF A06 CSCL 01/2

This report provides a summary and analysis of the data collected in the 1990 General Aviation Pilot and Aircraft Activity Survey. The survey was conducted at a random sample of general aviation airports across the nation during the months of June, July, August, and September 1990 by the Federal Aviation Administration with the assistance of the Civil Air Patrol. The survey data provides information regarding the magnitude and characteristics of general aviation including: type and source of weather information services, trip Length in time and distance, and pilot age and certification. Estimates are made of total 1990 general aviation operations, fuel consumption and aircraft miles flown. GRA

N91-30076 Loughborough Univ. of Technology (England). Dept. of Transport Technology.
A REVIEW OF UK AVIATION POLICY
Robert Caves Jul. 1991 47 p
(TT-9107; ISBN-0-904947-34-3) Copyright Avail: Issuing Activity

This is a short review of UK aviation policy which concentrates more on strategic than operational issues. It is concluded that, where it is possible to consider the industry's and the consumer's interest in isolation, there are few areas where policy needs to be improved. The present policy framework involves Dept. of Transportation and other branches of government in decisions in these areas: new runway location and bilateral negotiations. It is suggested that a more open forum is needed for the consideration of such issues as the role of airports in regional and national development; the balance between growth in traffic and damage to the environment; the advantages of competition compared with the costs of providing the infrastructure to give it free expression; the integration of all modes of transport; community goals for longer distance transport; the integration of UK and the European Economic Community policy with respect to non-EEC nations; and methods of monitoring monopolies. Author

N91-30077* National Aeronautics and Space Administration, Washington, DC.
AERONAUTICAL ENGINEERING: A CONTINUING BIBLIOGRAPHY WITH INDEXES (SUPPLEMENT 268)
Aug. 1991 131 p
(NASA-SP-7037(268); NAS 1.21:7037(268)) Avail: NTIS HC A07; NTIS standing order as PB89-914100, $23.00 domestic, $46.00 foreign CSCL 01B

This bibliography lists 406 reports, articles, and other documents introduced into the NASA scientific and technical information system in July, 1991. Subject coverage includes: design, construction and testing of aircraft and aircraft engines; aircraft components, equipment and systems; ground support systems; and theoretical and applied aspects of aerodynamics and general fluid dynamics. Author

02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer.*

N91-30078# Illinois Univ., Chicago. Dept. of Mechanical Engineering.
INTERFEROMETRIC TOMOGRAPHY OF HIGH-SPEED AERODYNAMIC FLOWS Final Report
Soyoung S. Cha 31 Aug. 1990 11 p
(Contract DAAL03-87-K-0098)
(AD-A229319; ARO-25014.8-EG) Avail: NTIS HC/MF A03 CSCL 20/4

Tomographic visualization of 3-D flow fields from multidirectional interferometric data has various advantages in its noninvasiveness and relatively high resolution and instantaneous capture of gross fields. The technique, however, encounters ill-posed problems: i.e., incompleted projection, limited angular scanning, and insufficient nonuniform data. Three typical methods were developed for accurately reconstructing flow fields from severely limited data. First, a general method termed the complementary field method (CFM) was developed in order to treat the all ill-posed problems in a unified manner. This iterative method can be combined with any direct reconstruction techniques. A special approach, which employs the CFM, was formulated for discontinuous shock reconstruction arising in aerodynamics. Second, direct reconstruction techniques based on continuous local

basis functions were developed. These techniques, utilizing higher order approximation, demonstrate better reconstruction of continuous fields. Third, a variable grid technique was develop to reflect intrinsic spatial resolution information contained in interferometric data. Test results demonstrate substantial error reduction when the CFM and an appropriate developed technique are coupled. GRA

N91-30079# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Aerospace and Ocean Engineering.
AN EXPERIMENTAL INVESTIGATION OF THE FLOW PAST AN IDEALIZED WING-BODY JUNCTION Final Report, 1 Jun. 1985 - 31 May 1990
William J. Devenport and Roger L. Simpson Jul. 1990 516 p
(Contract N00014-87-K-0421)
(AD-A229602; VPI-AOE-172) Avail: NTIS HC/MF A22 CSCL 20/4

Velocity measurements, pressure measurements and surface oil-flow visualizations, performed in the flow past an idealized wing-body junction, are presented. The junction consists of a cylindrical wing mounted normal to a flat surface on which an otherwise two-dimensional turbulent boundary is growing. The velocity measurements were made over a detailed grid using hot-wires and a three-component laser Doppler anemometer. At most locations all components of mean velocity and the Reynolds stress tensor were measured. These data clearly reveal, for the first time, the turbulence structure of the horseshoe vortex and the surrounding flow. The purpose of this report is to present the data in a form suitable for use by other researchers, especially those wishing to compute this flow. GRA

N91-30080*# AEDAR Corp., Landover, MD.
CONTROL OF HELICOPTER ROTORBLADE AERODYNAMICS
James A. Fabunmi Washington NASA Jul. 1991 50 p
(Contract NAS2-13095)
(NASA-CR-4350; A-91030; NAS 1.26:4350) Avail: NTIS HC/MF A03 CSCL 01A

The results of a feasibility study of a method for controlling the aerodynamics of helicopter rotorblades using stacks of piezoelectric ceramic plates are presented. A resonant mechanism is proposed for the amplification of the displacements produced by the stack. This motion is then converted into linear displacement for the actuation of the servoflap of the blades. A design which emulates the actuation of the servoflap on the Kaman SH-2F is used to demonstrate the fact that such a system can be designed to produce the necessary forces and velocities needed to control the aerodynamics of the rotorblades of such a helicopter. Estimates of the electrical power requirements are also presented. A Small Business Innovation Research (SBIR) Phase 2 Program is suggested, whereby a bench-top prototype of the device can be built and tested. A collaborative effort between AEDAR Corporation and Kaman Aerospace Corporation is anticipated for future effort on this project. Author

N91-30081*# Old Dominion Univ., Norfolk, VA. Dept. of Mechanical Engineering and Mechanics.
ANALYSIS AND CONTROL OF ASYMMETRIC VORTEX FLOWS AND SUPERSONIC VORTEX BREAKDOWN Progress Report, 1 Dec. 1990 - 31 Jul. 1991
Osama A. Kandil Aug. 1991 79 p
(Grant NAG1-994)
(NASA-CR-188637; NAS 1.26:188637) Avail: NTIS HC/MF A05 CSCL 01A

Topics relative to the analysis and control of asymmetric vortex flow and supersonic vortex breakdown are discussed. Specific topics include the computation of compressible, quasi-axisymmetric slender vortex flow and breakdown; supersonic quasi-axisymmetric vortex breakdown; and three-dimensional Navier-Stokes asymmetric solutions for cones and cone-cylinder configurations. For individual titles, see N91-30082 through N91-30083.

N91-30082*# Old Dominion Univ., Norfolk, VA. Dept. of Mechanical Engineering and Mechanics.
COMPUTATION OF COMPRESSIBLE QUASI-AXISYMMETRIC SLENDER VORTEX FLOW AND BREAKDOWN
Osama A. Kandil and Hamdy A. Kandil *In its* Analysis and Control of Asymmetric Vortex Flows and Supersonic Vortex Breakdown Aug. 1991 10 p Repr. from Computer Physics Communications, North-Holland Physics Publishing, No. 65, 1991 p 164-172 (For primary document see N91-30081 22-02)
Avail: NTIS HC/MF A05 CSCL 01A

The unsteady, compressible Navier-Stokes equations are used to compute and analyze compressible quasi-axisymmetric isolated vortices. The Navier-Stokes equations are solved using an implicit, upwind, flux difference splitting finite volume scheme. The developed three dimensional solver was verified by comparing its solution profiles with those of a slender, quasi-axisymmetric vortex solver for a subsonic, quasi-axisymmetric vortex in an unbounded domain. The Navier-Stokes solver is then used to solve for a supersonic, quasi-axisymmetric vortex flow in a configured circular duct. Steady and unsteady vortex-shock interactions and breakdown were captured. The problem was also calculated using the Euler solver of the same code; the results were compared with those of the Navier-Stokes solver. The effect of the initial swirl was investigated. Author

N91-30083*# Old Dominion Univ., Norfolk, VA.
SUPERSONIC QUASI-AXISYMMETRIC VORTEX BREAKDOWN
Osama A. Kandil, Hamdy A. Kandil, and C. H. Liu (National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.) *In its* Analysis and Control of Asymmetric Vortex Flows and Supersonic Vortex Breakdown Aug. 1991 14 p Presented at the 9th AIAA Applied Aerodynamics Conference, Baltimore, MD, 23-25 Sep. 1991 (For primary document see N91-30081 22-02)
(AIAA-91-3311-CP) Avail: NTIS HC/MF A05 CSCL 01A

An extensive computational study of supersonic quasi-axisymmetric vortex breakdown in a configured circular duct is presented. The unsteady, compressible, full Navier-Stokes (NS) equations are used. The NS equations are solved for the quasi-axisymmetric flows using an implicit, upwind, flux difference splitting, finite volume scheme. The quasi-axisymmetric solutions are time accurate and are obtained by forcing the components of the flowfield vector to be equal on two axial planes, which are in close proximity of each other. The effect of Reynolds number, for laminar flows, on the evolution and persistence of vortex breakdown, is studied. Finally, the effect of swirl ration at the duct inlet is investigated. Author

N91-30084 Georgia Inst. of Tech., Atlanta.
AN EXPERIMENTAL INVESTIGATION OF THE LEADING EDGE OF DIFFUSION FLAMES Ph.D. Thesis
Hau-Jei Chiang 1990 153 p
Avail: Univ. Microfilms Order No. DA9115375

This research is devoted to clarifying the nature and behavior of the Leading Edge portion of diffusion flames by experimental observations and the development of a phenomenological model. The motivation of the research originates from the need to better understand the combustion of composite solid propellants in rocket motors, especially the role played by the leading edge part of the oxidizer-fuel diffusion flame. Since experimental investigation of actual solid propellant flames is presently not possible in detail because of the microscopic scale of the combustion zone, this research has used an atmospheric pressure gas burner to investigate the characteristics and controlling processes in the leading edge flame zone. Specifically, tests using combustion photography and CH flame radiation measurement were conducted to examine the heat release rate of the LEF region and the subsequent diffusion flame. The effect of systematic variations of controllable parameters such as gas velocities and dilution levels were studied with the help of a Schlieren system, an M-Z interferometer and thermocouple measurement, to understand the characteristics of the LEF. The results indicate that the leading

edge flame zone has a heat release rate significantly higher than the rest of the diffusion flame. Dissert. Abstr.

N91-30085 Arizona State Univ., Tempe.
UNSTEADY SUBSONIC FLOW OVER ELASTIC AND RIGID BODIES INCLUDING WAKE EFFECT Ph.D. Thesis
Hee Woo Lee 1990 252 p
Avail: Univ. Microfilms Order No. DA9116761

An unsteady subsonic surface panel method (SPM) was developed for computations of unsteady pressures, forces, and moments for an arbitrary body in steady and oscillating motions, including the wake effect. The body under consideration can be rigid or elastic, closed-end or flat-based, and its geometry is allowed for slope discontinuities. The present SPM is completely general in the reduced frequency range, the mode shapes input, and is valid for all subsonic Mach numbers. For steady flow cases, good agreement is found with results of USSAERO, Hess's surface panel method and Revell's higher order theory. For rigid bodies in oscillation, extensive studies in terms of stability derivatives were carried out for verification with the slender body results and those obtained by Liu et al. and Revell. Also, a new line element method (LEM) was developed in parallel for method validation with the SPM in the general frequency range, the cylindrical panel flutter problem is computed and found in excellent agreement with Dowell and Widnall's analytical results. Most importantly, a new wake model is introduced to account for the wake-effect induced by flat-based bodies. The wake model is simple, direct, and requires no iteration. Computed results using the present SPM with the wake model show remarkable improvement over the no-wake results in correlation with the measured data. In the order of the body wake, the boundary layer thickness and the compressibility, all of which add up to the effect of stabilizing the flat-based body dynamically. Hence, the present SPM should be recognized as the first such unsteady method that fully includes the effects of body thickness, body bending mode, reduced frequency, and the body-wake interaction in its analysis, which was thoroughly validated with the existing experimental data for various body configurations in the complete subsonic range. Dissert. Abstr.

N91-30086 Stanford Univ., CA.
MEASUREMENT AND CONTROL OF THE UNSTEADY, SEPARATED FLOW DOWNSTREAM OF AN OSCILLATING SPOILER Ph.D. Thesis
Curtis Frederick Nelson 1991 222 p
Avail: Univ. Microfilms Order No. DA9115828

An experimental investigation of the unsteady, separated flow produced by the oscillation of a two-dimensional spoiler was performed, where the spoiler was located spanwise across the bottom wall of a low speed, rectangular wind tunnel. The investigation consisted of two parts: detailed measurements of the unsteady flow produced by the spoiler oscillation, and open loop control of the resulting unsteady flow. As part of the investigation, techniques were developed for acquiring the phase of laser Doppler anemometer (LDA) samples and for measuring and compensating the non-ideal gain and phase response of the pressure measurement system. Sinusoidal spoiler motion produced a flowfield dominated by the presence of a spanwise vortex. The dependence of this vortex on the spoiler oscillation frequency was investigated for reduced frequencies in the range of 0.025 to 0.06, using phase-averaged velocity data acquired along the tunnel centerline by the LDA system. Unsteady pressure data showed the presence of a characteristic, low pressure region on the wall below the vortex. The development of the unsteady vortex into a steady separation was investigated using a pitch and hold spoiler cycle. To exercise control over the unsteady vortex, various passive and active methods of open-loop control were performed. Active control utilized pulsed blowing and suction from spanwise slots located both upstream and downstream of the spoiler, and was able to strengthen or weaken the pressure field of the unsteady vortex by up to 40 percent. Lead or lag in the unsteady vortex shedding and convection of up to twice the spoiler chord convection time for the mean flow were easily achieved. Dissert. Abstr.

N91-30087 Georgia Inst. of Tech., Atlanta.
DYNAMIC STALL OF CIRCULATION CONTROL AIRFOILS Ph.D. Thesis
George D. Shrewsbury 1990 171 p Previously announced as A90-19923
Avail: Univ. Microfilms Order No. DA9115397

Lift modulation is required for rotorcraft applications since the retreating blade will always produce less lift due to the reduced dynamic pressure. A numerical study was made to evaluate the dynamic stall characteristics of an oscillating circulation control airfoil. An analysis procedure was used which provided an efficient solution to the 2-D, time accurate Navier-Stokes equations. This procedure includes the effects of compressibility and can provide solutions for regions which contain turbulent, separated flow. The computational code also implemented an eddy viscosity turbulence model which was modified to account for curved wall jets and the associated free shear layer. The results of the study indicate that circulation control may be a useful concept to effectively modulate the lift for rotorcraft applications. If the circulatory lift was not restored by the time the pitching cycle is completed, the lift cannot be the same as the starting value, and the hysteresis loop will bifurcate into a bimodal, two lobed characteristic. Dissert. Abstr.

N91-30088*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
EXTENSION OF MULTIGRID METHODOLOGY TO SUPERSONIC/HYPERSONIC 3-D VISCOUS FLOWS Final Report
Veer N. Vatsa, Eli Turkel, and J. S. Abolhassani (Computer Sciences Corp., Hampton, VA.) Aug. 1991 25 p Submitted for publication
(Contract NAS1-18605)
(NASA-CR-187612; NAS 1.26:187612; ICASE-IR-91-66) Avail: NTIS HC/MF A03 CSCL 01A

A multigrid acceleration technique developed for solving 3-D Navier-Stokes equations for subsonic/transonic flows was extended to supersonic/hypersonic flows. An explicit multistage Runge-Kutta type of time stepping scheme is used as the basic algorithm in conjunction with the multigrid scheme. Solutions were obtained for a blunt conical frustum at Mach 6 to demonstrate the applicability of the multigrid scheme to high speed flows. Computations were performed for a generic High Speed Civil Transport configuration designed to cruise at Mach 3. These solutions show both the efficiency and accuracy of the present scheme for computing high speed viscous flows over configurations of practical interest. Author

N91-30089*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
THE INVISCID COMPRESSIBLE GOERTLER PROBLEM Final Report
Andrew Dando (Manchester Univ., England) and Sharon O. Seddougui Jul. 1991 41 p Submitted for publication
(Contract NAS1-18605)
(NASA-CR-187600; NAS 1.26:187600; ICASE-IR-91-54) Avail: NTIS HC/MF A03 CSCL 01A

The growth rate is studied of Goertler vortices in a compressible flow in the inviscid limit of large Goertler number. Numerical solutions are obtained for 0(1) wavenumbers. The further limits of large Mach number and large wavenumber with 0(1) Mach number are considered. It is shown that two different types of disturbance modes can appear in this problem. The first is a wall layer mode, so named as it has its eigenfunctions trapped in a thin layer away from the wall and termed a trapped layer mode for large wavenumbers and an adjustment layer mode for large Mach numbers, since then this mode has its eigenfunctions concentrated in the temperature adjustment layer. The near crossing of the modes which occurs in each of the limits mentioned is investigated. Author

N91-30090*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
UNSTRUCTURED-GRID METHODS DEVELOPMENT: LESSONS LE ARNED
John T. Batina Aug. 1991 8 p Presented at the 4th International Symposium on Computational Fluid Dynamics, Davis, CA, 9-12 Sep. 1991
(NASA-TM-104137; NAS 1.15:104137) Avail: NTIS HC/MF A02 CSCL 01A

The development is summarized of unstructured grid methods for the solution of the equations of fluid flow and some of the lessons learned are shared. The 3-D Euler equations are solved, including spatial discretizations, temporal discretizations, and boundary conditions. An example calculation with an upwind implicit method using a CFL (Courant Friedricks Lewy) number of infinity is presented for the Boeing 747 aircraft. The results obtained in less than one hour of CPU time on a Cray-2 computer, thus demonstrating the speed and robustness of the present capability. Author

N91-30091 Defence Research Establishment Atlantic, Dartmouth (Nova Scotia).
CORRECTING WIND TUNNEL FORCE MEASUREMENTS FOR WIND LOADING DEFLECTIONS OF THE MODEL
George D. Watt Oct. 1989 29 p
(DREA-89-225; CTN-91-60195) Avail: NTIS HC A03

In the fall of 1988, the Defence Research Establishment Atlantic (DREA) carried out tests on a 6 metre long submarine model in the National Aeronautical Establishment 9 by 9 metre wind tunnel in Ottawa. Accuracy requirements were such that force data needed to be corrected for body axes transformation and gravitional tare errors resulting from wind loading deflections of the model. These errors occur both with balances mounted external to the tunnel and internal to the model, and are significant if model mass and/or wind loading deflections are large. Analytical procedures are presented for correcting both internal and external balance measurements, and the transformation of those measurements to a body fixed coordinate system in the model, for wind loading deflections. The model is assumed to be infinitely stiff. Deflections are assumed to occur in the support struts and the load cells of the internal balance. Although straightforward, the corrections are dependent on mass, stiffness, and various geometric parameters of the model and support strut system which were not easily obtained. In addition, a rigorous analysis has shown that only single point tares are required for yaw sweep testing with internal balances susceptible to small pitch and roll variations over the sweep, providing the net wind-on pitch and roll angles are known relative to their tare values. CISTI

N91-30092*# Texas A&M Univ., College Station. Dept. of Aerospace Engineering.
EXPERIMENTAL VERIFICATION OF A NEW LAMINAR AIRFOIL: A PROJECT FOR THE GRADUATE PROGRAM IN AERONAUTICS Final Report
Oran W. Nicks and Kenneth D. Korkan 16 Aug. 1991 41 p
(Grant NAG1-1260)
(NASA-CR-188772; NAS 1.26:188772) Avail: NTIS HC/MF A03 CSCL 01A

Two reports on student activities to determine the properties of a new laminar airfoil which were delivered at a conference on soaring technology are presented. The papers discuss a wind tunnel investigation and analysis of the SM701 airfoil and verification of the SM701 airfoil aerodynamic charcteristics utilizing theoretical techniques. The papers are based on a combination of analytical design, hands-on model fabrication, wind tunnel calibration and testing, data acquisition and analysis, and comparison of test results and theory. M.G.

N91-30093*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
MULTIGRID FOR HYPERSONIC VISCOUS TWO- AND THREE-DIMENSIONAL FLOWS Final Report
E. Turkel, R. C. Swanson, V. N. Vatsa, and J. A. White (Analytical Services and Materials, Inc., Hampton, VA.) Jul. 1991 24 p Previously announced in IAA as A91-40746 Submitted for publication
(Contract NAS1-18605)
(NASA-CR-187603; NAS 1.26:187603; ICASE-91-57) Avail: NTIS HC/MF A03 CSCL 01A

The use of a multigrid method with central differencing to solve the Navier-Stokes equations for hypersonic flows is considered. The time dependent form of the equations is integrated with an explicit Runge-Kutta scheme accelerated by local time stepping and implicit residual smoothing. Variable coefficients are developed for the implicit process that removes the diffusion limit on the time step, producing significant improvement in convergence. A numerical dissipation formulation that provides good shock capturing capability for hypersonic flows is presented. This formulation is shown to be a crucial aspect of the multigrid method. Solutions are given for two-dimensional viscous flow over a NACA 0012 airfoil and three-dimensional flow over a blunt biconic. Author

N91-30094*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
NONLINEAR INSTABILITY OF HYPERSONIC FLOW PAST A WEDGE Final Report
Sharon O. Seddougui and Andrew P. Bassom (Exeter Univ., England) Jul. 1991 43 p Submitted for publication
(Contracts NAS1-18605; SERC-XG-10176)
(NASA-CR-187609; NAS 1.26:187609; ICASE-91-63) Avail: NTIS HC/MF A03 CSCL 01A

The nonlinear stability of a compressible flow past a wedge is investigated in the hypersonic limit. The analysis follows the ideas of a weakly nonlinear approach. Interest is focussed on Tollmien-Schlichting waves governed by a triple deck structure and it is found that the attached shock can profoundly affect the stability characteristics of the flow. In particular, it is shown that nonlinearity tends to have a stabilizing influence. The nonlinear evolution of the Tollmien-Schlichting mode is described in a number of asymptotic limits. Author

N91-30095*# California Polytechnic State Univ., San Luis Obispo.
THE POWER INDUCED EFFECTS MODULE: A FORTRAN CODE WHICH ESTIMATES LIFT INCREMENTS DUE TO POWER INDUCED EFFECTS FOR V/STOL FLIGHT Report, 1 Jan. 1990 - 30 Sep. 1991
Doral R. Sandlin and Kipp E. Howard Jul. 1991 297 p
(Contract NCC2-664)
(NASA-CR-188081; NAS 1.26:188081) Avail: NTIS HC/MF A13 CSCL 01A

A user friendly FORTRAN code that can be used for preliminary design of V/STOL aircraft is described. The program estimates lift increments, due to power induced effects, encountered by aircraft in V/STOL flight. These lift increments are calculated using empirical relations developed from wind tunnel tests and are due to suckdown, fountain, ground vortex, jet wake, and the reaction control system. The code can be used as a preliminary design tool along with NASA Ames' Aircraft Synthesis design code or as a stand-alone program for V/STOL aircraft designers. The Power Induced Effects (PIE) module was validated using experimental data and data computed from lift increment routines. Results are presented for many flat plate models along with the McDonnell Aircraft Company's MFVT (mixed flow vectored thrust) V/STOL preliminary design and a 15 percent scale model of the YAV-8B Harrier V/STOL aircraft. Trends and magnitudes of lift increments versus aircraft height above the ground were predicted well by the PIE module. The code also provided good predictions of the magnitudes of lift increments versus aircraft forward velocity. More experimental results are needed to determine how well the code predicts lift increments as they vary with jet deflection angle and angle of attack. The FORTRAN code is provided in the appendix. M.G.

N91-30096*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
AN EFFECTIVE MULTIGRID METHOD FOR HIGH-SPEED FLOWS Final Report
R. C. Swanson, E. Turkel, and J. A. White (Analytical Services and Materials, Inc., Hampton, VA.) Jul. 1991 28 p Submitted for publication
(Contract NAS1-18605)
(NASA-CR-187602; NAS 1.26:187602; ICASE-91-56) Avail: NTIS HC/MF A03 CSCL 01A

The use is considered of a multigrid method with central differencing to solve the Navier-Stokes equations for high speed flows. The time dependent form of the equations is integrated with a Runge-Kutta scheme accelerated by local time stepping and variable coefficient implicit residual smoothing. Of particular importance are the details of the numerical dissipation formulation, especially the switch between the second and fourth difference terms. Solutions are given for 2-D laminar flow over a circular cylinder and a 15 deg compression ramp. Author

N91-30097*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
ON THE LINEAR STABILITY OF COMPRESSIBLE PLANE COUETTE FLOW Final Report
Peter W. Duck (Manchester Univ., England), Gordon Erlebacher, and M. Yousuff Hussaini Jul. 1991 53 p Submitted for publication
(Contract NAS1-18605)
(NASA-CR-187610; NAS 1.26:187610; ICASE-91-64) Avail: NTIS HC/MF A04 CSCL 01A

The linear stability of compressible plane Couette flow is investigated. The correct and proper basic velocity and temperature distributions are perturbed by a small amplitude normal mode disturbance. The full small amplitude disturbance equations are solved numerically at finite Reynolds numbers, and the inviscid limit of these equations is then investigated in some detail. It is found that instability can occur, although the stability characteristics of the flow are quite different from unbounded flows. The effects of viscosity are also calculated, asymptotically, and shown to have a stabilizing role in all the cases investigated. Exceptional regimes to the problem occur when the wavespeed of the disturbances approaches the velocity of either of the walls, and these regimes are also analyzed in some detail. Finally, the effect of imposing radiation-type boundary conditions on the upper (moving) wall (in place of impermeability) is investigated, and shown to yield results common to both bounded and unbounded flows. Author

N91-30098*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
FULL-SCALE SEMISPAN TESTS OF A BUSINESS-JET WING WITH A NATURAL LAMINAR FLOW AIRFOIL
David E. Hahne and Frank L. Jordan, Jr. Sep. 1991 52 p
(NASA-TP-3133; L-16905; NAS 1.60:3133) Avail: NTIS HC/MF A04 CSCL 01A

A full-scale semispan model was investigated to evaluate and document the low-speed, high-lift characteristics of a business-jet class wing that utilized the HSNLF(1)-0213 airfoil section and a single-slotted flap system. Also, boundary-layer transition effects were examined, a segmented leading-edge droop for improved stall/spin resistance was studied, and two roll-controlled devices were evaluated. The wind-tunnel investigation showed that deployment of single-slotted, trailing-edge flap was effective in providing substantial increments in lift required for takeoff and landing performance. Fixed-transition studies to investigate premature tripping of the boundary layer indicated no adverse effects in lift and pitching-moment characteristics for either the cruise or landing configuration. The full-scale results also suggested the need to further optimize the leading-edge droop design that was developed in the subscale tests. Author

N91-30099# Aeritalia S.p.A., Turin (Italy). Defence Aircraft Group.
AERODYNAMIC ANALYSIS OF THE FLOW CHARACTERISTICS OF A DELTA-CANARD CONFIGURATION
A. Ferretti and A. Salvatore 1990 12 p Presented at the 17th Congresso Internaz. ICAS 1990, Stockholm, Sweden, 9-14 Sep. 1990 Previously announced in IAA as A91-24472
(ETN-91-99774) Avail: NTIS HC/MF A03

A complete cycle of aerodynamic analysis of the local flow characteristics on a delta canard aircraft configuration is performed through the examination of wind tunnel and flight data covering subsonic-transonic and supersonic regimes. A pressure plotting wind tunnel model scale 1:13, is tested in different entries in wind tunnels. Flow characteristics are investigated in the whole Mach alpha range of interest, analyzing development of vortex flow on the wing surface and the effects of canard on it. Key aerocharacteristics, like trailing edge pressure and minimum pressure coefficient on the wing, are identified and correlated to the insurgance of peculiar flow structures obtaining a prediction criterion from attached to vortex flow. The availability of inflight pressure measurement over the flying surfaces of BAe E.A.P. demonstrator aircraft allows for comparison of wind tunnel versus flight data. The effects of varying the Reynolds number are evaluated. A comparison of the experimental results with computational estimates is carried out in order to assess the reliability of the theoretical methods in predicting complex three dimensional flow fields. ESA

N91-30100# Aeritalia S.p.A., Turin (Italy). Defence Aircraft Group.
INVISCID CALCULATIONS BY AN UPWIND FINITE ELEMENT METHOD OF HYPERSONIC FLOWS OVER A DOUBLE (SIMPLE) ELLIPSE
V. Selmin and L. Formaggia 1990 17 p Presented at the Conference on Flows for Reentry Vehicles, Antibes, France, 22-25 Jan. 1990
(ETN-91-99776) Avail: NTIS HC/MF A03

The quest of better designed reentry vehicles has caused the development of more sophisticated solution algorithms which take into account the complex chemical phenomena associated with high speed flows. As a result of that, the number of variables involved and the complexity of the equations has increased considerably. In this context, the optimization of the number of mesh points required for a given solution accuracy is of paramount importance. Unstructured grids are considered best suited to handle large variations of grid size, putting more points exactly where needed and allowing a straightforward implementation of adaptive strategies. An unstructured grid approach is therefore chosen. An inviscid flow solver able to operate on such grids is developed. The solver employs an hybrid finite volume/finite element algorithm and some upwind concepts reformulated in the context of unstructured triangular grids. The upwind decomposition of the fluxes provides a way for combining accurate and robust schemes, able to cope effectively with very strong shock phenomena. ESA

N91-30101# Aeritalia S.p.A., Turin (Italy). Defence Aircraft Group.
INVISCID CALCULATIONS BY AN UPWIND FINITE ELEMENT METHOD OF HYPERSONIC FLOWS OVER A DOUBLE (SINGLE) ELLIPSE
V. Selmin and L. Formaggia 1990 26 p Presented at the Conference on Flows for Reentry Problems, Antibes, France, 22-25 Jan. 1990
(ETN-91-99777) Avail: NTIS HC/MF A03

The quest for better designed reentry vehicles has caused the development of more sophisticated solution algorithms which take into account the complex chemical phenomena associated with high speed flows. As a result, the number of variables involved and the complexity of the equations has increased considerably. In this context, the optimization of the number of mesh points required for a given solution accuracy is of paramount importance. Unstructured grids are considered best suited to handle large

variations of grid size, placing more points exactly where needed and allowing a straightforward implementation of adaptive strategies. An unstructured grid approach is therefore chosen. An inviscid flow solver able to operate on such grids is developed. This solver employs a hybrid finite volume/finite element algorithm and upwind concepts reformulated in the context of unstructured triangular grids. The upwind decomposition of the fluxes provides a way to obtain accurate and robust schemes, able to cope effectively with very strong shock phenomena. ESA

N91-30102# Aeritalia S.p.A., Turin (Italy). Defence Aircraft Group.
SIMULATION OF HYPERSONIC FLOWS ON UNSTRUCTURED GRIDS
V. Selmin and L. Formaggia 1990 4 p Presented at Congress on Computation Mechanics, Stuttgart, Fed. Republic of Germany, 27-31 Aug. 1990
(ETN-91-99778) Avail: NTIS HC/MF A01

The study of high speed flows is receiving attention by aerospace industries in connection with the design of high supersonic transport aircrafts and reentry vehicles. The development of effective numerical solvers is of particular interest due to the difficulties and high costs associated with experimental work at this flow regime. High speed flow is characterized by the importance of forms of energy which are normally neglected at lower speed, namely the excitation of vibrational degrees of freedom, dissociation and ionization. The solution algorithm must take into account, to some degree, all or some of these mechanisms of energy transfer. In addition, the flow solution normally presents strong shocks and shock interactions. The code must be able to capture those features without spurious oscillations. Simulation systems taking all these factors into consideration are presented. ESA

N91-30103# Aeritalia S.p.A., Turin (Italy). Defence Aircraft Group.
NUMERICAL SIMULATION OF VISCOUS TURBULENT FLOWS PAST AEROSPACE CONFIGURATIONS
Nicola Ceresola and Sandra Tarditi 1990 18 p Presented at the Conference on Computing: Achievements, Problems, and Prospects, Capri, Italy, 3-7 Jun. 1990
(ETN-91-99779) Avail: NTIS HC/MF A03

A numerical code for the simulation of three dimensional viscous compressible flows is developed. The steady, thin layer Navier-Stokes equations are solved with a finite differences, implicit, approximate factorization method. A semi-implicit marching algorithm in one space direction is applied to ensure input/output efficiency on a vector computer. The code is applied to flows ranging from low subsonic to high supercritical regime past wing geometries; comparisons are made with available experimental data. Satisfactory results are obtained. ESA

N91-30104# European Space Agency, Paris (France).
A CONTRIBUTION TO THE NUMERICAL SIMULATION OF TRANSONIC FLOW AROUND A DELTA WING BY SOLVING THE NAVIER-STOKES EQUATIONS Ph.D. Thesis - Karlsruhe Univ.
Achim Hilgenstock (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Goettingen, Germany, F.R.) May 1991 121 p Transl. into ENGLISH of Ein Beitrag zur Numerische Simulation der Transsonischen Stroemung um Einen Deltafluegel Durch Loesung der Navier-Stokes,schen Bewegungsgleichungen (Goettingen, Fed. Republic of Germany, DLR), Dec. 1989 99 p Original language document was announced as N91-10026
(ESA-TT-1225; DLR-FB-90-13; ETN-91-99805) Avail: NTIS HC/MF A06

Turbulent flow around a delta wing at incidence was simulated using a finite volume method. A brief explanation of the selection criteria for suitable computer grids and grid generation was set out. Numerical simulation is performed by means of a simple algebraic model for turbulence. On the basis of a delta wing with a sharp leading edge, the dependency of the numerical solution on the computer grids is discussed. The influence of the position of the transition line in respect of realistic wing/fuselage configuration is investigated. Numerical results are compared with experimental data. An interpretation of flow in the primary separation area is done. In the process, an explanation for the zone in the primary vortex which is observed by laser light sheet to be almost devoid of particles is performed. Mach number distribution, and velocity, temperature, pressure and total pressure distributions are discussed by relating them to streamlines in the vortex area. ESA

N91-30105# European Space Agency, Paris (France).
WIND TUNNEL INVESTIGATIONS OF THE APPEARANCE OF SHOCKS IN THE WINDWARD REGION OF BODIES WITH CIRCULAR CROSS SECTION AT ANGLE OF ATTACK
Helmut Esch (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne, Germany, F.R.) May 1991 75 p Transl. into ENGLISH of Windskanaluntersuchungen zum Auftreten von Verdichtungsstoessen im Luvgebeit von Angestellten Kreiszylindrischen Ruempfen (Cologne, Fed. Republic of Germany, DLR), 15 Mar. 1990 63 p Original language document was announced as N91-10027
(ESA-TT-1226; DLR-FB-90-15; ETN-91-99806) Avail: NTIS HC/MF A04; Original German version available from DLR, WissenschaftlichesBerichtsw esen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 31 DM

The conditions causing the primary embedded shock to bend into the windward region of a circular cylinder at incidence are investigated by using Schlieren photographs, oil film patterns and measurements of surface pressure distribution. The critical crossflow Mach number range between 0.3 and 0.6 is covered by free stream Mach numbers between 1.25 and 2.5. The Reynolds numbers, based on body diameter, vary between 300,000 and 1,300,000. ESA

N91-30106# Aeritalia S.p.A., Turin (Italy).
COMPARISON OF SOLUTION OF VARIOUS EULER SOLVERS AND ONE NAVIER-STOKES SOLVER FOR THE FLOW ABOUT A SHARP-EDGED CROPPED DELTA WING
B. R. Williams, W. Kordulla, M. Borsi, and H. W. M. Hoeijmakers (National Aerospace Lab., Amsterdam, Netherlands) 1991 6 p Sponsored by Ministry of Defence; Bundesministerium fuer Verteidigung; Italian Ministry of Defence; and Netherlands Agency for Aerospace Programs
(ETN-91-99508) Avail: NTIS HC/MF A02

For the flow about a sharp edged cropped 65 degree delta wing numerical solutions obtained with different Euler methods are compared with each other, with the numerical solution of a Reynolds averaged Navier-Stokes method and with experimental data. At the selected free stream Mach number of 0.85 and angle of attack of 10 degree the flow features a leading edge vortex, is transonic, but contains weak shocks only. The results of the Euler methods were obtained on one and the same C-H type of grid with close to 300,000 cells. This investigation indicates that for the test case considered there are, from a theoretical point of view, significant differences between results from different Euler methods, even if artificial dissipation is minimized. However, the correlation of the Euler solutions with experimental data shows much larger differences due to the failure to represent secondary separation in the Euler methods and is therefore unsatisfactory. The results of the Reynolds averaged Navier-Stokes method demonstrate an improved correlation of theory and experiment. ESA

N91-30107# Aeritalia S.p.A., Turin (Italy). Computational Fluid Dynamics.
VORTICAL FLOW SIMULATION BY USING STRUCTURED AND UNSTRUCTURED GRIDS
M. Borsi, L. Formaggia, E. Hettena, S. Santillan, V. Selmin, and S. Tarditi 1991 12 p
(ETN-91-99509) Avail: NTIS HC/MF A03

Two Euler equation solvers on finite volume formulations on structured and unstructured grids are applied to the simulation of transonic vortical flow around a delta wing body configuration.

The mesh generation techniques are described, some details on the flow solvers are given, and a comparison between the methods is presented. ESA

N91-30108# Aeronautical Research Inst. of Sweden, Stockholm. Aerodynamics Dept.
MATGRID, A PROGRAM FOR GENERATION OF C-H AND C-O TOPOLOGY GRIDS AROUND WING/BODY CONFIGURATIONS: INSTALLATION GUIDE
Sven G. Hedman and Lars G. Tysell Mar. 1991 15 p Sponsored by Swedish National Board for Technical Development
(FFA-TN-1989-39; ETN-91-99546) Avail: NTIS HC/MF A03

MATGRID is a computer program for generation of C-H or C-O topology grids for the discretization of flow fields around configurations consisting of a wing alone or a wing and a fuselage. It was developed primarily for use together with the full potential flow solver MATRICS. The content of the installation tape and the execution of the examples included as test cases are described. ESA

03 AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation.*

N91-30109# Coast Guard, Washington, DC. Office of Research and Development.
MODEL TESTS OF INFLATABLE LIFE RAFTS IN BREAKING WAVES Final Report
Carol L. Hervey and Donald J. Jordan Feb. 1990 35 p
(AD-A229406; USCG-D-05-90) Avail: NTIS HC/MF A03 CSCL 01/3

Model tests were conducted to investigate the capsizing of inflatable life rafts when struck by a breaking wave. The life raft models were tested with and without water ballast compartments. Three configurations of water ballast compartments were evaluated: four rectangular bags arranged symmetrically on the bottom of the raft, a single toroidal bag, and a single hemispherical bag. The unballasted raft was considerably capsized. The ballasted rafts were not capsized with any of the three ballast configurations. GRA

N91-30110 National Transportation Safety Board, Washington, DC.
AIRCRAFT ACCIDENT REPORT: RUNWAY COLLISION OF EASTERN AIRLINES BOEING 727, FLIGHT 111 AND EPPS AIR SERVICE BEECHCRAFT KING AIR A100, ATLANTA HARTSFIELD INTERNATIONAL AIRPORT, 18 JANUARY 1990
29 May 1991 101 p
(PB91-910403; NTSB/AAR-91/03) Avail: NTIS HC/MF A06 CSCL 01C

The runway collision of an Eastern Airlines Boeing 727 with an Epps Air Service Beechcraft at the Hartsfield International Airport, Atlanta, GA, on January 8, 1990, is examined. The safety issues discussed are air traffic controller procedures, conspicuity of airplane lighting, the see and avoid concept, and equipment and systems to prevent runway incursions. Safety recommendations concerning these issues were made to the FAA. Author

N91-30111 Defence and Civil Inst. of Environmental Medicine, Downsview (Ontario).
THE DYNAMIC PERFORMANCE OF A VARIETY OF SEAT CUSHION MATERIALS UNDER VERTICAL IMPACT LOADS
D. R. Day Dec. 1988 151 p Sponsored by Department of National Defence
(DCIEM-88-TR-53; CTN-91-60207) Avail: NTIS HC A08

A series of twenty-nine impacts using the HyGe Crash Simulator at the Impact Studies Facility of the Defence and Civil Institute of Environmental Medicine (DCIEM) was performed in order to determine the effectiveness of a variety of seat cushion materials in preventing spinal injuries during high accelerative loading. These commonly occur during helicopter crashes with relatively large vertical velocity components, hard landings of Schweizer training gliders, and ejections from jet aircraft. Two simple wooden seats were mounted on the impact sled so as to simulate impacts in the vertical (bottom of seat pan to top) direction only, with a velocity change of 21 miles per hour, with a peak deceleration of 17 G. The results showed that none of the energy-absorbing cushions tested had any significant effect on the probable occurrence, of spinal injury. However, 2-inch, and thicker foam-rubber cushions increased the risk of spinal injury significantly, with the probable severity of the injury increasing as the thickness of the foam increased. Author (CISTI)

N91-30112 Defence and Civil Inst. of Environmental Medicine, Downsview (Ontario).
CANADIAN AIRCREW FRESH WATER SURVIVAL 1952-1987
C. J. Brooks Dec. 1988 24 p
(DCIEM-88-RR-51; CTN-91-60209) Avail: NTIS HC A03

This paper reviews all aircraft accidents from 1952 to 1987 involving Royal Canadian Air Force or Canadian Forces aircrew ditching, parachuting or ejecting into fresh water. In that period there have been a total of 42 accidents involving 105 personnel. The survival rate was 61 percent compared with a 57 percent survival rate in sea water accidents. All rescues were completed in under 12 hours. Aircrews had less than 1 minute warning in 81 percent of the accidents. There were fatalities in 53 percent of the short warning accidents. Seventeen types of aircraft were involved in the accidents. There was one case of clinical hypothermia and 5 cases in which the crew were very cold and survival was attributed principally to quick rescue. Difficulties have occurred in inflating life jackets and deploying the life raft. Otherwise there is little data on the performance of these items. Immersion suits were not worn in any accidents. In general the problems encountered in ditching in fresh water were the same as those encountered in ditching in sea water. CISTI

N91-30113# Federal Aviation Administration, Atlantic City, NJ.
EFFECTIVENESS OF WATER SPRAY WITHIN THE CABIN OVERHEAD AREA
Timothy Marker Aug. 1991 27 p
(DOT/FAA/CT-TN91/29) Avail: NTIS HC/MF A03

Four full-scale postcrash fire tests were conducted in a modified DC-10 fuselage to investigate the benefits, if any, of spraying water in the area above the cabin ceiling, known as the overhead. The tests were part of a 28-test series using a wide body fuselage to study the performance of an onboard cabin water spray system. The spray system uses low flow rate nozzles which produce a fine mist consisting of a range of water droplet diameters. The system being tested was a breadboard design for the purpose of demonstrating concept feasibility only. In order to better quantify the overhead spray performance, two areas of the cabin ceiling were removed: the area directly adjacent to the fire door, and an area in the forward section of the fuselage near the gas sampling stations. Temperature, smoke, heat, and gas concentrations were monitored at various locations throughout the fuselage. Test results showed little or no improvement in cabin conditions due to the overhead spray. Author

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Space Communications, Spacecraft Communications, Command and Tracking* and *Communications and Radar.*

N91-30114# Analytic Sciences Corp., Reading, MA.
OMEGA SYSTEM AVAILABILITY AS A GLOBAL MEASURE OF NAVIGATION ACCURACY Final Report, Mar. - Sep. 1990
Peter B. Morris Sep. 1990 82 p
(Contract DTCG23-89-C-20008)
(AD-A229492; TIM-5834-5-1; USCG-ONSCEN-05-90) Avail: NTIS HC/MF A05 CSCL 17/7

An augmented Omega System Availability model is presented in which system availability is treated as the probability that navigation accuracy is better than a selected threshold. In addition to the four sub-models used in connection with the previously developed System Availability Model, two new sub-models are presented which are needed for a probabilistic description of navigation accuracy as a measure of Omega system availability. One new sub-model describes the sources and statistical distribution of Omega phase errors, while the other sub-model defines the transformation of phase error to position error based on a generic method of Omega navigation commonly used in conventional airborne Omega navigation receiver systems. Resources required for the calculation of the system availability index based on the augmented model are estimated. Finally, as an alternative to the probabilistic model, a very simple GDOP-type form is proposed which could be included as a collective signal criterion in the current deterministic version of the PACE workstation. GRA

N91-30115# Massachusetts Inst. of Tech., Lexington. Lincoln Lab.
AUTOMATED FLIGHT STRIP MANAGEMENT SYSTEM FUNCTIONAL DESCRIPTION
S. D. Thompson 19 Nov. 1990 48 p
(Contract DTFA01-89-Z-02039)
(AD-A229606; ATC-174; FAA-ARD-90/27) Avail: NTIS HC/MF A03 CSCL 01/5

The purpose of this document is to provide a functional description of the Automated Strip Management System (ASMS). ASMS is designed to be an improvement over the current manual system of paper flight data strips, plastic holders, metal racks and felt-tip markers now employed in the Tower Cabs and TRACONS at major airports. The objectives for ASMS include improved coordination between controllers, a reduction of controller workload, and the automation of most manual record keeping procedures. ASMS will provide position-specific information to the controller when he or she needs it in a manner that displays the data in the most useable form for the controller to accomplish his or her job. ASMS will provide a better interface with controllers for data entry and transfer than exists with the present manual system, reducing the chance for errors and increasing productivity. Additionally, ASMS is intended to provide the Traffic Management Unit (TMU) in the Air Route Traffic Control Center (ARTCC) real time ground information suitable for traffic management, reducing or eliminating the requirement for voice communications. In addition to the objective listed above, the implementation ASMS at Logan Tower will remedy a deficiency in the existing system for passing Flight Progress Strip data for departing aircraft from the Tower Cab to the TRACON located in an adjacent building. GRA

N91-30116# Federal Aviation Administration, Atlantic City, NJ.
AIR TRAFFIC OPERATIONAL EVALUATION PLAN FOR THE LIMITED PRODUCTION AUTOMATED SURFACE OBSERVING SYSTEM (ASOS)
Elizabeth Turcich and Bruce E. Ware Sep. 1991 21 p
(DOT/FAA/CT-TN91/13) Avail: NTIS HC/MF A03

The Automated Surface Observing System (ASOS) is a weather collection and display system that will be installed in air traffic control towers (ATCT). Data for the operational evaluation of the limited production ASOS system will be collected via questionnaires completed by air traffic control specialists at the three operational sites. The results of the evaluation will be used for consideration in making any necessary changes to the ASOS system prior to full production. Author

N91-30117# Computer Resource Management, Inc., Herndon, VA.
NAVIGATION OPERATIONAL CONCEPT
William Trent, Thomas Pickerell, and Harold Nelson, Jr. Aug. 1991 59 p
(Contract DTFA01-91-Y-01004)
(NAS-SR-134; DOT/FAA/SE-91/2) Avail: NTIS HC/MF A04

A requirement for the National Airspace (NAS) is to provide for navigation, as identified in the NAS System Requirements Specification (NASSRS). This operational concept is one of many high level documents that will, in total, describe the operation of the NAS when the projected upgrade is complete. These documents will assist in linking the requirements specified in the NASSRS, including enroute navigation, terminal navigation, and visual navigation aids. This concept, and the other seven operational concepts, will complete the description of the system requirements as described in the NASSRS. The eight operation concepts are: communications, navigation, monitoring, maintenance and support, system effectiveness, air defense, flight planning, and traffic control and airspace management. Author

N91-30118 Miller Communications Systems Ltd., Kanata (Ontario).
STUDY OF THE EFFECT OF MULTIPATH ON MODERN DF ALGORITHMS, APPENDIX C Final Report
Kenneth S. Lazaris-Brunner Mar. 1989 344 p
(Contract DREO-660ER-7-0003/96-ER)
(CTN-91-60176) Avail: NTIS HC A15

The relative performance of new high resolution algorithms used for radio direction finding have been evaluated for the Defence Research Establishment of Canada using computerized simulations. This report presents the architecture of the program used to simulate the algorithms and evaluates algorithm performance. The simulation program was programmed in FORTRAN-77 for the MCS Vax 750 computer. Programming changes required to convert the program to another system are described. The various algorithms employed in the simulations are described and the mathematical formulas used in computation are given. The performance of the three best high resolution algorithms (MUSIC, ESPRIT, and Thermal Noise) for radio direction finding were compared using a conventional phase interferometric method in a multipath environment. It was found that the advanced algorithms did not perform better than the conventional algorithm in this environment. ESPRIT performed worse. An extension of MUSIC to a multipath algorithm involving a multidimensional search gave better performance than the single ray algorithms for a 1 and 2-ray multipath. For a 3-ray multipath, its performance was similar to that of the single ray algorithm. For more than 3-ray multipaths it did not work at all. It appears that the dimensions of the search must be greater than or equal to the number of coherent incoming rays. This limitation, coupled with its non-performance for more than 3-ray multipath impose severe limitations on its use. In addition, multidimensional searches were extremely time consuming. CISTI

N91-30119# Aeronautical Research Inst. of Sweden, Stockholm. Flight Systems Dept.
INVESTIGATION OF SPEECH SYSTEMS FOR GROUND COLLISION WARNING IN MILITARY AIRCRAFT
Ruta Axelsson and Folke Stoby Apr. 1991 65 p
(Contract FMV-82420-89-325-73-001)
(FFA-TN-1991-05; ETN-91-99787) Avail: NTIS HC/MF A04

A trend in both civil and military cockpit design is to incorporate some kind of speech system in the presentation of information.

The decision has been made by Swedish Air Material department to introduce suitable speech systems in the aircraft Viggen and in the aircraft Gripen. A flight simulator experiment is used to investigate the following alternatives for ground collision warning: two types of speech generation, synthesized and digitized, female and male voices, six different words, lamp warning. To be able to create a realistic flight mission, a specific test method is designed. The flight task consists of head up as well as head down flying and the missions contain realistic ground collision warning situations. A tape recorded from authentic radio communication is used as a realistic background. As a further test of intelligibility for the different speech systems, unknown randomly positioned flight phrases are included. The results are unambiguous regarding the preference for speech systems but not so pronounced for the choice of warning words. ESA

N91-30120# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Abt. fuer Systemtechnik und Navigation.
THE AIRPORT AND AIRSPACE SIMULATION MODEL SIMMOD OF THE FAA: FEATURES, EXAMPLES, AND EXPERIENCES
Franz Knabe Dec. 1990 27 p In GERMAN; ENGLISH summary
(DLR-Mitt-91-01; ISSN-0939-298X; ETN-91-99792) Avail: NTIS HC/MF A03; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 12.50 DM

The Institute for Flight Guidance of the German Aerospace Research Establishment uses the airport and airspace simulation model SIMMOD of the Federal Aviation Administration (FAA) during a study on refinements to increase the capacity of the Frankfurt airport. The environment, in which the software package is operated, the structure and the features of SIMMOD are described. Some personal viewpoints from the work with SIMMOD are presented. ESA

N91-30121 Civil Aviation Authority, London (England).
UK AIRMISSES INVOLVING COMMERCIAL AIR TRANSPORT, JANUARY - APRIL 1990
Dec. 1990 36 p
(ISSN-0951-6301; ETN-91-99834) Copyright Avail: Civil Aviation Authority, Greville House, 37 Gratton Road, Cheltenham, England

A list of airmisses involving commercial aircraft during the period from Jan. to Apr. 1990 is presented. Only the pilot of the aircraft can file an airmiss report and the decision to do so is exclusively his or hers. All airmiss reports in the United Kingdom (UK) airspace involving civil or military aircraft are investigated initially by the Joint Airmiss Section of the National Air Traffic Services. The airmisses are categorized as A, B or C in assessment of the degree of risk inherent in each airmiss. ESA

N91-30122 Civil Aviation Authority, London (England).
UK AIRMISSES INVOLVING COMMERCIAL AIR TRANSPORT, MAY - AUGUST 1990
Apr. 1991 85 p
(ISSN-0951-6301; ETN-91-99835) Copyright Avail: Civil Aviation Authority, Greville House, 37 Gratton Road, Cheltenham, England

A list of airmisses involving commercial aircraft during the period from May to Aug. 1990 is presented. Only the pilot of the aircraft can file an airmiss report and the decision to do so is exclusively his or hers. All airmiss reports in the United Kingdom (UK) airspace involving civil or military aircraft are investigated initially by the Joint Airmiss Section of the National Air Traffic Services. The airmisses are categorized as A, B or C in assessment of the degree of risk inherent in each airmiss report. ESA

N91-30123# Royal Signals and Radar Establishment, Malvern (England).
THE PROFILE DATA STRIP: A NEW APPROACH TO THE PRESENTATION OF FLIGHT PROGRESS DATA
J. O. Cook and D. A. Baseley Feb. 1991 17 p Original contains color illustrations
(RSRE-Memo-4460; BR116728; ETN-91-99844) Copyright Avail: NTIS HC/MF A03

Advanced air traffic control systems are being designed to make full use of developments in aircraft flight management systems and air ground data links. Current flight progress displays do not represent in any detail the actions or intentions of aircraft. A method of using automation and modern graphic displays to make the presentation of flight progress data more dynamic and easily understood is described. ESA

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics.* For land transportation vehicles see *85 Urban Technology and Transportation.*

N91-30124# Systems Control Technology, Inc., Arlington, VA.
ROTORCRAFT USE IN DISASTER RELIEF AND MASS CASUALTY INCIDENTS: CASE STUDIES Final Report
Sandra Henninger, Jack Thompson, and Robert Newman Jun. 1990 122 p
(Contract DTFA01-87-C-00014)
(AD-A229569) Avail: NTIS HC/MF A06 CSCL 01/3

The primary purposes of this report are to document helicopter involvement in disaster relief efforts and to bring about an understanding of the general nature of such helicopter operations. A representative series of 18 case histories detailing disaster situations (i.e., airliner crashes, high rise fires, natural disasters, etc.) where helicopters have been involved in rescue and relief operations are studied in a case history format. Each case addresses to the greatest extent possible the circumstances of the disaster, the extent of rescue and relief efforts, the nature and extent of relief planning done prior to the incident in question, the nature of actual rotorcraft involvement, the number of people endangered in the situation, the number of people assisted through the application of rotorcraft, the success or non-success of the rotorcraft participation, analysis of the rotorcraft application, the types of landing areas used, and documentation of lessons learned and post-situation analyses. In the 18 case studies presented, rotorcraft transported approximately 3,357 people and contributed to the saving of approximately 187 lives. GRA

N91-30125*# Oklahoma Univ., Norman. School of Aerospace and Mechanical Engineering.
AN INTEGRATED AERODYNAMIC/PROPULSION STUDY FOR GENERIC AERO-SPACE PLANES BASED ON WAVERIDER CONCEPTS Final Report
G. Emanuel and M. L. Rasmussen Aug. 1991 26 p
(Grant NAG1-886)
(NASA-CR-188691; NAS 1.26:188691) Avail: NTIS HC/MF A03 CSCL 01C

Research efforts related to the development of a unified aerospace plane analysis based on waverider technology are summarized. Viscous effects on the forebodies of cone-derived waverider configurations were studied. A simple means for determining the average skin friction coefficient of laminar boundary layers was established. This was incorporated into a computer program that provides lift and drag coefficients and lift/drag ratio for on-design waveriders when the temperature and Reynolds number based on length are specified. An effort was made to carry out parabolized Navier-Stokes (PNS) calculations for cone-derived waveriders. When the viscous terms were turned off (in the Euler mode) computations for elliptic cone-derived waveriders could be carried out for a wide range of on-design and off-design situations. Work related to waveriders derived from power law shocks is described in some detail. M.G.

N91-30126*# Princeton Univ., NJ. Dept. of Mechanical and Aerospace Engineering.
AN ANALYTICALLY LINEARIZED HELICOPTER MODEL WITH IMPROVED MODELING ACCURACY Interim Report, 1 Aug. 1990 - 1 Aug. 1991
Patrick T. Jensen, H. C. Curtiss, Jr., and Robert M. McKillip, Jr. Aug. 1991 88 p
(Grant NAG2-561)
(NASA-CR-188715; NAS 1.26:188715) Avail: NTIS HC/MF A05 CSCL 01C

An analytically linearized model for helicopter flight response including rotor blade dynamics and dynamic inflow, that was recently developed, was studied with the objective of increasing the understanding, the ease of use, and the accuracy of the model. The mathematical model is described along with a description of the UH-60A Black Hawk helicopter and flight test used to validate the model. To aid in utilization of the model for sensitivity analysis, a new, faster, and more efficient implementation of the model was developed. It is shown that several errors in the mathematical modeling of the system caused a reduction in accuracy. These errors in rotor force resolution, trim force and moment calculation, and rotor inertia terms were corrected along with improvements to the programming style and documentation. Use of a trim input file to drive the model is examined. Trim file errors in blade twist, control input phase angle, coning and lag angles, main and tail rotor pitch, and uniform induced velocity, were corrected. Finally, through direct comparison of the original and corrected model responses to flight test data, the effect of the corrections on overall model output is shown. Author

N91-30127# National Aeronautical Lab., Bangalore (India).
PROPOSED MODIFICATIONS. IMPROVEMENTS TO THE DRAFT SPECIFICATIONS OF DGCA, NEW DELHI, ON REQUIREMENTS FOR AIRWORTHINESS CERTIFICATION OF EXPERIMENTAL AIRCRAFT
R. B. Damania and P. T. Varute Mar. 1991 32 p
(NAL-PD-FE-9101) Avail: NTIS HC/MF A03

Changes and modifications suggested by the authors to the original draft of the DRD, DGCA, New Delhi, on Requirements for Airworthiness Certification of Experimental Aircraft are documented. Topics covered include aircraft design and construction, security clearance, general operation and flight rules, inspections, recommended safety precautions, a recommendation for logging flight data, the issuance of the unrestricted special airworthiness certificate, and additional requirements for rotorcraft, gliders, and sailplanes. Author

N91-30128*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Facility, Edwards, CA.
THE ROLE OF THE REMOTELY AUGMENTED VEHICLE (RAV) LABORATORY IN FLIGHT RESEARCH
Dorothea Cohen and Jeanette H. Le Sep. 1991 16 p Presented at the AIAA Flight Simulation Technologies Conference and Exhibit, New Orleans, LA, 12-14 Aug. 1991
(NASA-TM-104235; H-1728; NAS 1.15:104235) Avail: NTIS HC/MF A03 CSCL 01C

An overview is presented of the unique capabilities and historical significance of the Remotely Augmented Vehicle (RAV) Lab at NASA-Dryden. The role is reviewed of the RAV Lab in enhancing flight test programs and efficient testing of new aircraft control laws. The history of the RAV Lab is discussed with a sample of its application using the X-29 aircraft. The RAV Lab allows for closed or open loop augmentation of the research aircraft while in flight using ground based, high performance real time computers. Telemetry systems transfer sensor and control data between the ground and the aircraft. The RAV capability provides for enhanced computational power, improved flight data quality, and alternate methods for the testing of control system concepts. The Lab is easily reconfigured to reflect changes within a flight program and can be adapted to new flight programs. Author

N91-30129 California Univ., Los Angeles.
NONLINEAR COUPLED ROTOR-FUSELAGE VIBRATION ANALYSIS AND HIGHER HARMONIC CONTROL STUDIES FOR VIBRATION REDUCTION IN HELICOPTERS Ph.D. Thesis
Ioanis Papavassiliou 1991 313 p
Avail: Univ. Microfilms Order No. DA9115438

A fundamental study of vibration prediction and vibration reduction in helicopters using active controls is performed. The nonlinear equations of motion for a coupled rotor/flexible fuselage system were derived using computer algebra on a special purpose symbolic computing facility. The details of the derivation using the symbolic manipulation program MACSYMA are described. The analysis is carried out for two different rotor-fuselage configurations, namely one which has an offset hinged spring restrained rigid blade model and another with fully elastic blades. The trim state and vibratory response of the helicopter are obtained in a single pass by applying the harmonic balance technique for all rotor and fuselage degrees of freedom. The influence of the fuselage flexibility on the vibratory response is studied. Open loop higher harmonic control (HHC) studies are performed to determine the optimal HHC inputs necessary to minimize either the vibratory hub shears or accelerations at various fuselage locations. It is shown that when the fuselage is modelled as a flexible body, conventional single frequency HHC is capable of reducing either the hub loads or on the fuselage accelerations but not both simultaneously. It is demonstrated that for simultaneous reduction of hub shears and fuselage accelerations a new scheme called multiple higher harmonic control (MHHC) is required. The fundamental aspects of this scheme are described in detail. A physical explanation of the MHHC control inputs for simultaneous reduction of hub shears and fuselage acceleration is provided. The effects, on the MHHC scheme, of varying the advance ratio, changing the fuselage flexibility and using the acceleration levels at different locations inside the fuselage as the objective function to be minimized are studied. Furthermore, a multiple blade tracking (MBT) analysis capability is developed which enables one to determine the response of each individual blade comprising the rotor system. This treatment allows the evaluation of the vibratory response of the rotor and the fuselage when the blades are not tracking. Finally, effectiveness of the MHHC scheme combined with MBT is demonstrated. The results obtained indicate that MHHC has very significant potential for vibration in rotorcraft.
Dissert. Abstr.

N91-30130*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Facility, Edwards, CA.
A PRELIMINARY INVESTIGATION OF THE USE OF THROTTLES FOR EMERGENCY FLIGHT CONTROL
F. W. Burcham, Jr., C. Gordon Fullerton, Glenn B. Gilyard, Thomas D. Wolf, and James F. Stewart Sep. 1991 24 p Presented at the 27th Joint Propulsion Conference, Sacramento, CA, 24-26 Jun. 1991; sponsored by AIAA, ASME, SAE, and ASEE Previously announced as A91-41731
(NASA-TM-4320; H-1737; NAS 1.15:4320; AIAA-91-2222)
Copyright Avail: NTIS HC/MF A03 CSCL 01C

A preliminary investigation was conducted regarding the use of throttles for emergency flight control of a multiengine aircraft. Several airplanes including a light twin-engine piston-powered airplane, jet transports, and a high performance fighter were studied during flight and piloted simulations. Simulation studies used the B-720, B-727, MD-11, and F-15 aircraft. Flight studies used the Lear 24, Piper PA-30, and F-15 airplanes. Based on simulator and flight results, all the airplanes exhibited some control capability with throttles. With piloted simulators, landings using manual throttles-only control were extremely difficult. An augmented control system was developed that converts conventional pilot stick inputs into appropriate throttle commands. With the augmented system, the B-720 and F-15 simulations were evaluated and could be landed successfully. Flight and simulation data were compared for the F-15 airplane. Author

N91-30131*# Systems Control Technology, Inc., Palo Alto, CA.
APPLICATION OF MODERN CONTROL DESIGN METHODOLOGY TO OBLIQUE WING RESEARCH AIRCRAFT
James H. Vincent Jul. 1991 134 p Sponsored by NASA. Dryden Flight Research Center
(Contract N00421-85-D-0155)
(NASA-TM-105058; NAS 1.15:105058; SCT-4520-280-1) Avail: NTIS HC/MF A07 CSCL 01C

A Linear Quadratic Regulator synthesis technique was used to design an explicit model following control system for the Oblique Wing Research Aircraft (OWRA). The forward path model (Maneuver Command Generator) was designed to incorporate the desired flying qualities and response decoupling. The LQR synthesis was based on the use of generalized controls, and it was structured to provide a proportional/integral error regulator with feedforward compensation. An unexpected consequence of this design approach was the ability to decouple the control synthesis into separate longitudinal and lateral directional designs. Longitudinal and lateral directional control laws were generated for each of the nine design flight conditions, and gain scheduling requirements were addressed. A fully coupled 6 degree of freedom open loop model of the OWRA along with the longitudinal and lateral directional control laws was used to assess the closed loop performance of the design. Evaluations were performed for each of the nine design flight conditions. Author

N91-30132*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Facility, Edwards, CA.
REAL-TIME IN-FLIGHT ENGINE PERFORMANCE AND HEALTH MONITORING TECHNIQUES FOR FLIGHT RESEARCH APPLICATION
Ronald J. Ray, John W. Hicks, and Keith D. Wichman Sep. 1991 34 p
(NASA-TM-104239; H-1750; NAS 1.15:104239) Avail: NTIS HC/MF A03 CSCL 01C

Procedures for real time evaluation of the inflight health and performance of gas turbine engines and related systems were developed to enhance flight test safety and productivity. These techniques include the monitoring of the engine, the engine control system, thrust vectoring control system health, and the detection of engine stalls. Real time performance techniques were developed for the determination and display of inflight thrust and for aeroperformance drag polars. These new methods were successfully shown on various research aircraft at NASA-Dryden. The capability of NASA's Western Aeronautical Test Range and the advanced data acquisition systems were key factors for implementation and real time display of these methods. Author

N91-30133# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Abt. Mathematische Verfahren und Datentechnik.
SOME RESULTS OF ATTAS FLIGHT DATA ANALYSIS USING MAXIMUM LIKELIHOOD PARAMETER ESTIMATION METHOD
Girija Gopalratnam and Ravindra Jategaonkar (Technische Univ., Brunswick, Germany, F.R.) Feb. 1991 46 p
(DLR-FB-91-04; ISSN-0939-2963; ETN-91-99541) Avail: NTIS HC/MF A03; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 19.50 Deutsch marks

The maximum likelihood parameter estimation method for nonlinear systems is applied to estimate from flight data at a few selected flight conditions the aerodynamic derivatives of the ATTAS (Advanced Technologies Testing Aircraft System). The coupled equations of aircraft motion pertaining to the longitudinal and lateral directional motion in the wind axis system and an aerodynamic model in terms of nondimensional derivatives are employed. In addition, details of the specially carried out flight maneuvers which enable separate estimation of the two pitch damping derivatives due to the pitch rate and rate of change of angle of attack from flight data, are provided. ESA

N91-30134# National Aerospace Lab., Amsterdam (Netherlands). Flight Div.
A MEASUREMENT SYSTEM FOR PRODUCTION FLIGHT TESTS OF NEW AIRCRAFT
R. vandeLeijgraaf, W. A. vanDorp, S. StormvanLeeuwen, and R. Udo 1 Aug. 1989 17 p Previously announced in IAA as A91-20984
(NLR-TP-89222-U; ETN-91-99644) Avail: NTIS HC/MF A03

A measurement system developed for production flight tests with the Fokker 50 and the Fokker 100 production aircraft is described. The objectives of this sytem and its composition (the data acquisition module and the data processing module) are addressed. The measurement system for the production flight test is described with the emphasis on the hardware and software description of the data processing module. The use of the system in the operational phase and experience from the first few flights with this system are given. ESA

N91-30135# National Aerospace Lab., Amsterdam (Netherlands). Flight Div.
MRVS: A SYSTEM FOR MEASURING, RECORDING AND PROCESSING FLIGHT DATA
J. T. M. vanDoorn, P. J. H. M. Manders, O. vanTeunenbroek, G. Pascoe, H. Riebeek, and A. Voskes (Fokker B.V., Amsterdam, Netherlands) 19 May 1988 23 p Presented at the 16th ICAS Congress, Jerusalem, Israel, Aug. 1988
(NLR-MP-88034-U; ETN-91-99650) Avail: NTIS HC/MF A03

A new system for measuring, recording and processing flight test data with the MRVS (Dutch acronym) is described. The requirements which led to a unique, highly modular design which facilitates the construction of flight test instrumentation systems that are optimally adapted to the test program and test aircraft under consideration, are presented. The subsystems, which have unique features, are described in detail. The operational experience with up to 20 different test aircraft and instrumentation systems is discussed. It is concluded that until now MRVS has outperformed its specifications. Less than 1 percent of test time has been lost due to instrumentation malfunction. ESA

N91-30136*# Douglas Aircraft Co., Inc., Long Beach, CA.
THE 1989 HIGH-SPEED CIVIL TRANSPORT STUDIES Summary Report
Sep. 1991 22 p
(Contract NAS1-18378)
(NASA-CR-187545; NAS 1.26:187545) Avail: NTIS HC/MF A03 CSCL 01C

The results of the Douglas Aircraft Company system studies related to high speed civil transports (HSCT) are discussed. The studies were conducted to assess the environmental compatibility of a high speed civil transport at a design Mach number of 3.2. Sonic boom minimization, external noise, and engine emissions were assessed together with the effect of the laminar flow control (LFC) technology on vehicle gross weight. The general results indicated that a sonic boom loudness level of 90-PLdB at Mach 3.2 may not be achievable for a practical design; the high flow engine cycle concept shows promise of achieving the sideline FAR Part 36 noise limit, but may not achieve the aircraft range design goal of 6,500 nautical miles; the rich burn/quick quench (RB/QQ) combustor concept shows promise for achieving low EINO sub x levels when combined with a premixed pilot stage/advanced technology, high power stage duct burner in the Pratt and Whitney variable steam control engine (VSCE); and full chord wing LFC has significant performance and economic advantages relative to the turbulent wing baseline. Author

06 AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography.*

N91-30137# National Aeronautical Lab., Bangalore (India).
GRAPHIC DISPLAY OF COCKPIT INSTRUMENTS FOR FLIGHT SIMULATION
K. Krishna Murthy and S. Balakrishna Jun. 1991 46 p Original contains color illustrations
(NAL-PD-FC-9111) Avail: NTIS HC/MF A03

A generalized software to visualize the behavior of an aircraft in simulated flight, through cockpit instruments was designed and developed. The display is achieved by incorporating the Masscomp Aurora Graphics routines in the program. It was found that the update time of display of various parameters is 20 milliseconds.
Author

N91-30138 Nottingham Univ. (England).
ELECTROSTATIC TRANSDUCERS FOR AIRBORNE ULTRASONICS Ph.D. Thesis
Hilary J. Carr 1989 346 p
Avail: Univ. Microfilms Order No. BRD-91981

Work in which both ultrasonic and optical experimental techniques have been used to study ultrasonic electrostatic transducers designed to operate in air is described. The results were compared to an analytical model. The frequency response of a transducer was found to be dependent on both the gross surface features and the microscopic features of a backplate, such as grooves and the surface roughness respectively. The results obtained show that the resonant frequency of a transducer assembled with a backplate that possessed a roughened surface was determined primarily by the mean depth of the air layer formed between the membrane and the backplate, with a shallow air depth producing a high resonant frequency. In addition, they indicated that for smooth optically flat backplates, the depth of the air layer was governed by the surface of the membrane. A Michelson interferometer was used to determine high resonant frequencies which when measured ultrasonically were found to be attenuated by air. It was found that the intensity of the frequency response of transducers constructed with a roughened surface backplates was governed by both the mean depth of the trapped air layer and the average wavelength of the backplates' surface. A detailed optical investigation of a transducer assembled with a grooved backplate showed that the multi-peaked frequency response observed was a consequence of the annular membranes formed by the transducer membrane above the grooves. The annular membranes were shown to be driven by the action of the membrane above adjacent rails. It is the frequency response of the annular membrane that forms the frequency response of a transducer. However, it was found that the resonant frequency of a transducer could correspond to an overtone of the natural frequency and not the natural frequency of the annular membrane. The frequency which forms the resonant frequency of the transducer is influenced by the ratio of the rail width to groove width. In general, the intensity of the frequency response of transducers was found to be determined by the width of a groove, with a narrower annular membrane producing the more intense response.
Dissert. Abstr.

N91-30139# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.).
AVIONICS SYSTEMS FOR FUTURE HELICOPTERS [AVIONIK-SYSTEME FUER ZUKUENFTIGE HUBSCHRAUBER]
Rudolf Schranner 16 May 1990 23 p In GERMAN Presented at the 18th Hubschrauberforum Bueckeburg, Bueckeburg, Fed. Republic of Germany, 16 May 1990
(MBB-UD-0591-90-PUB; OTN-013096; ETN-91-99446) Avail: NTIS HC/MF A03

The boundary conditions for system design are given, e.g., user requirements, technology, and integration aspects such as available mass/volume. The interaction of these categories of requirements are shown. The economical aspect and market competition are prevailing for civil projects. The essential element of design of avionics system is the systematic analysis of user requirements. The external integration conditions, such as environmental requirements, radiation safety and standardization of housings exert an influence on avionics design. The aim of system design is to meet with user analysis function, using available technology and considering integration aspects. When taking these conditions into account, a number of possible systems are defined by combination and suitable integration.
ESA

N91-30689# Joint Publications Research Service, Arlington, VA.
ANALYSIS OF METHODS OF PRESENTING INFORMATION TO AN OPERATOR IN THE CONTROL PROCESS Abstract Only
Yu. P. Yablonko and V. F. Anishchenko *In its* JPRS Report: Science and Technology. USSR: Life Sciences 19 Feb. 1991 p 3-4 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 23, no. 4, Jul.-Aug. 1989 p 83-85 (For primary document see N91-30683 22-52)
Avail: NTIS HC/MF A04

07 AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxilliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

N91-30140# Massachusetts Inst. of Tech., Cambridge. Gas Turbine Lab.
AIR FORCE RESEARCH IN AERO PROPULSION TECHNOLOGY (AFRAPT) Final Report, 1 Sep. 1989 - 31 Aug. 1990
J. Dugundji, A. Epstein, M. Giles, E. Greitzer, and M. Martinez-Sanchez 27 Sep. 1990 30 p
(Grant AF-AFOSR-0288-85)
(AD-A229612; AFOSR-90-1154TR; AFOSR-A4) Avail: NTIS HC/MF A03 CSCL 21/5

This research grant consisted of ten separate projects: (1) Turbomachinery noise reduction through distortion amelioration; (2) Fluid mechanics of discrete passage diffusers; (3) Compressor stabilization through structural feedback; (4) Linearized Euler solutions for turbomachinery flutter and forced response; (5) Vortical flow behavior downstream of convoluted trailing edges; (6) Turbine blade tip forces; (7) Influence of inlet radial temperature distribution on turbine rotor heat transfer; (8) Effect of circumferential inlet distortion on the formation of turbine secondary flow vortices; (9) Inlet distortion with application to STOVL; and (10) Instability and distortion in multistage compressors.
GRA

N91-30141*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
THE NAVY/NASA ENGINE PROGRAM (NNEP89): A USER'S MANUAL
Robert M. Plencner and Christopher A. Snyder Aug. 1991 118 p
(NASA-TM-105186; E-6484; NAS 1.15:105186) Avail: NTIS HC/MF A06 CSCL 21E

An engine simulation computer code called NNEP89 was written to perform 1-D steady state thermodynamic analysis of turbine engine cycles. By using a very flexible method of input, a set of standard components are connected at execution time to simulate almost any turbine engine configuration that the user could imagine. The code was used to simulate a wide range of engine cycles from turboshafts and turboprops to air turborockets and supersonic cruise variable cycle engines. Off design performance is calculated through the use of component performance maps. A chemical equilibrium model is incorporated to adequately predict chemical

dissociation as well as model virtually any fuel. NNEP89 is written in standard FORTRAN77 with clear structured programming and extensive internal documentation. The standard FORTRAN77 programming allows it to be installed onto most mainframe computers and workstations without modification. The NNEP89 code was derived from the Navy/NASA Engine program (NNEP). NNEP89 provides many improvements and enhancements to the original NNEP code and incorporates features which make it easier to use for the novice user. This is a comprehensive user's guide for the NNEP89 code. Author

N91-30142*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
COMPARISON OF A QUASI-3D ANALYSIS AND EXPERIMENTAL PERFORMANCE FOR THREE COMPACT RADIAL TURBINES
P. S. Simonyi (Sverdrup Technology, Inc., Brook Park, OH.) and R. J. Boyle 1991 15 p Presented at the 27th Joint Propulsion Conference, Sacramento, CA, 24-27 Jun. 1991; sponsored by AIAA, SAE, ASME, and ASEE Previously announced as A91-45789
(Contract NAS3-25266)
(NASA-TM-105155; E-6441; NAS 1.15:105155; AIAA-91-2128)
Avail: NTIS HC/MF A03 CSCL 21E

An experimental aerodynamic evaluation of three compact radial turbine builds was performed. Two rotors which were 40 to 50 percent shorter in axial length than conventional state of the art radial rotors were tested. A single nozzle design was used. One rotor was tested with the nozzle at two stagger angle settings. A second rotor was tested with the nozzle in only the closed down setting. Experimental results were compared to predict results from a quasi-3D inviscid and boundary layer analysis, called Meridl/Tsonic/Blayer (MTSB). This analysis was used to predict turbine performance. It has previously been calibrated only for axial, not radial, turbomachinery. The predicted and measured efficiencies were compared at the design point for the three turbines. At the design points the analysis overpredicted the efficiency by less than 1.7 points. Comparisons were also made at off-design operating points. The results of these comparisons showed the importance of an accurate clearance model for efficiency predictions and also that there are deficiencies in the incidence loss model used. Author

N91-30143# National Aerospace Lab., Amsterdam (Netherlands). Structures and Materials Div.
HIGH TEMPERATURE RESEARCH AT NLR
C. E. W. Looije 10 Aug. 1988 14 p In DUTCH; ENGLISH summary Submitted for publication
(NLR-MP-88051-U; ETN-91-99653) Avail: NTIS HC/MF A03

High temperature research activities and test facilities at the NLR is surveyed. Research is directed towards the life extension of gas turbine components. Special attention is paid to corrosion prevention, materials selection, advanced repair techniques and life prediction. ESA

N91-30144# Royal Aerospace Establishment, Farnborough (England).
DESIGN OF ADVANCED BLADING FOR A HIGH-SPEED HP COMPRESSOR USING AN S1-S2 FLOW CALCULATION SYSTEM
R. B. Ginder, A. J. Britton, W. J. Calvert, I. R. I. McKenzie, and Judith M. Parker 30 Nov. 1990 14 p Presented at the I Mech E European Conference on Turbomachinery, London, England, 19-20 Mar. 1991
(RAE-TM-P-1196; BR300630; ETN-91-99853) Copyright Avail: NTIS HC/MF A03

A set of advanced blading has been designed for a five stage high speed research core compressor. The blade profiles were aerodynamically tailored using a sophisticated S1-S2 flow calculation system which incorporates inviscid-viscous blade to blade code. The design and measured performance of the compressor are compared with an initial conventionally bladed four stage version. The new design achieved a peak level of polytropic efficiency approaching 91 pct., a substantial improvement on the initial version. ESA

N91-30145# Royal Aerospace Establishment, Farnborough (England).
TURBINE NOZZLE GUIDE VANE EXIT AREA TRAVERSING IN A SHORT DURATION LIGHT PISTON TEST FACILITY
S. P. Harasgama and K. S. Chana 18 Dec. 1990 26 p Presented at the 10th International Symposium on Measuring Techniques for Transonic and Supersonic Flows in Cascades and Turbomachines, Rhode Saint Genese, Belgium, 17-18 Sep. 1990 Original contains color illustrations
(RAE-TM-P-1199; BR300632; ETN-91-99855) Copyright Avail: NTIS HC/MF A03

Tests were performed in an Isentropic Light Piston Cascade (ILPC) facility to measure the total pressure loss of turbine Nozzle Guide Vanes (NGV). A three hole non nulling probe was utilized with a fast acting traverse which gives a full circumferential sweep over two blade wakes in approximately 500 to 700 ms. Two types of probes were used: the first with high frequency response sensors mounted within 25 mm of the probe tip, and the second with low response sensors mounted 500 mm away from the probe tip using lengths of pneumatic tubing. Results are presented for both probe types which indicate the wake decay between 0.2 and 1.0 axial chords downstream of NGV trailing edge. A full area traverse is also shown which indicates the areas of secondary flow downstream of the blade row. ESA

N91-30146# Royal Aerospace Establishment, Farnborough (England).
DESIGN AND PERFORMANCE OF ADVANCED BLADING FOR A HIGH-SPEED HP COMPRESSOR
R. B. Ginder 15 Jan. 1991 14 p Presented at the 36th ASME International Gas Turbine and Aeroengine Congress, Orlando, FL, 3-6 Jun. 1991
(RAE-TM-P-1201; BR301645; ETN-91-99893) Copyright Avail: NTIS HC/MF A03

A set of advanced blading was designed for a five stage high speed research cone compressor. The blade profiles were aerodynamically tailored using a sophisticated quasi three dimensional S1-S2 flow calculation system. This system involves iteration between blade to blade calculations using an inviscid viscous code, and a streamline curvature calculation for the pitchwise averaged throughflow. The design and measured performance of the new compressor are compared with an initial conventionally bladed four stage version. The new design achieved a peak level of polytropic efficiency approaching 91 percent, a substantial improvement on the initial version, but showed a shortfall in pressure ratio compared with design intent. Post test analyses based on measured performance data are used to give further insight into this result and indicate possible improvements in the design approach. ESA

N91-30147# Royal Aerospace Establishment, Farnborough (England).
APPLICATION OF S1BYL2 TO THE AGARD WG18 COMPRESSOR TEST CASES
W. J. Calvert 27 Feb. 1991 21 p Presented at the 77th AGARD Propulsion and Energetics Panel Symposium on CFD Techniques for Propulsion Applications, San Antonio, TX, 27-31 May 1991
(RAE-TM-P-1204; BR301533; ETN-91-99894) Copyright Avail: NTIS HC/MF A03

S1BYL2 is an inviscid viscous blade to blade method for calculating the detailed aerodynamics and overall performance of compressor blades. It may be applied either on its own to predict the flow for individual blade sections, such as the mid span of a linear cascade, or in conjunction with a throughflow calculation to predict the performance of a complete axial compressor. New predictions for the V2 and ARL SL19 cascades and for the high speed compressor cases are presented. It is hoped that this will be one of many sets of calculations for these cases, so that an

improved understanding of each case may be obtained, together with an appreciation of the strengths and weaknesses of different computational approaches. ESA

08 AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

For related information see also *05 Aircraft Design, Testing and Performance.*

N91-30148# Air Force Flight Dynamics Lab., Wright-Patterson AFB, OH.
PROCEEDINGS OF THE 4TH NASA/DOD CONTROL/STRUCTURES INTERACTION TECHNOLOGY CONFERENCE Final Report
Andrew D. Swanson 15 Jan. 1991 769 p Conference held in Orlando, FL, 5-7 Nov. 1990
(AF Proj. 2401)
(AD-A235843; WL-TR-91-3013) Avail: NTIS HC/MF A99 CSCL 22/1

The topics covered include: control systems development, sensors and actuators, integrated design, and ground and flight experiments. Major subtopics include: large space structures, passive damping, control/structures interaction, and vibration control. GRA

N91-30149# Aeronautical Research Labs., Melbourne (Australia).
F/A-18 1/9TH SCALE MODEL TAIL BUFFET MEASUREMENTS
C. A. Martin, M. K. Glaister, L. D. MacLaren, L. A. Meyn, and J. Ross (National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.) Jun. 1991 35 p
(ARL-Flight-Mech-R-188; AR-006-149) Copyright Avail: NTIS HC/MF A03

Wind tunnel tests were carried out on a 1/9th scale model of the F/A-18 at high angles of attack to investigate the characteristics of tail buffet due to bursting of the wing leading edge extension (LEX) vortices. The tests were carried out at the Aeronautical Research Laboratory low-speed wind tunnel facility and form part of a collaborative activity with NASA Ames Research Center, organized by The Technical Cooperative Program (TTCP). Information from the program will be used in the planning of similar collaborative tests, to be carried out at NASA Ames, on a full-scale aircraft. The program covered the measurement of unsteady pressures and fin vibration for cases with and without the wing LEX fences fitted. Fourier transform methods were used to analyze the unsteady data, and information on the spatial and temporal content of the vortex burst pressure field was obtained. Flow visualization of the vortex behavior was carried out using smoke and a laser light sheet technique. Author

N91-30150*# Oregon State Univ., Corvallis. Dept. of Electrical and Computer Engineering.
NONLINEAR STABILITY AND CONTROL STUDY OF HIGHLY MANEUVERABLE HIGH PERFORMANCE AIRCRAFT Annual Report
R. R. Mohler 12 Aug. 1991 82 p
(Grant NAG1-1081)
(NASA-CR-188721; NAS 1.26:188721; OSU-ECE-91-01) Avail: NTIS HC/MF A05 CSCL 01C

The purpose was to develop and apply new nonlinear system methodologies to the stability analysis and adaptive control of high angle of attack (alpha) aircraft such as the F-18. Considerable progress is documented on nonlinear adaptive control and associated model development, identification, and simulation. The analysis considered linear and nonlinear, longitudinal, high alpha aircraft dynamics with varying degrees of approximation dependent on the purpose. In all cases, angle of attack or pitch rate was controlled primarily by a horizontal stabilizer. In most cases studied, a linear adaptive controller provided sufficient stability. However, it has been demonstrated by simulation of a simplified nonlinear model that certain large rapid maneuvers were not readily stabilized by the investigated linear adaptive control, but were controlled instead by means of a nonlinear time-series based adaptive control. Author

N91-30151 Georgia Inst. of Tech., Atlanta.
ACTIVE CONTROL OF SMART STRUCTURES: THEORY AND EXPERIMENT Ph.D. Thesis
Chin Chung Won 1990 274 p
Avail: Univ. Microfilms Order No. DA9115403

The structural model and control schemes in controlling the bending-torsional vibrations of smart beams were developed. Experiments were conducted for a bending vibration problem to validate the theoretical model. The energy method is used to derive the equations of motion and Maxwell's equations for the active structure consisting of an elastic body, piezoelectric sensors, and actuators. Based on the basic energy, five governing equations are obtained in terms of five generalized displacements. The electromechanical vibration problems are decoupled, and in the process of decoupling the governing equations, applied voltages are converted into mechanical forces. The mechanical equations of motion are solved for the mechanical displacements by the finite element method developed for the active beams, and Maxwell's equations are used to solve the electric displacements and to describe the sensor dynamical equations when the piezoceramics are used as the sensing devices. The analog signal conditioner bandpass filter/phase shifter/power amplifier is used as a controller. Each signal conditioner is turned to control one mode. The design of the free parameters in the controller is based on a hybrid method. The dynamic parts of the controller are selected by inspecting the dynamics of the open loop system, and the controller gains are designed by using an optimal output feedback control scheme. The phenomenon of control structures interaction was studied in the closed loop systems by using the proposed controller. The control objective is to reduce the magnitude of the transfer functions of the closed loop system below the value of the open loop system at the resonant frequencies, and achieve disturbance rejection at specified locations on the structure and for specified input locations.
Dissert. Abstr.

N91-30152*# Stanford Univ., CA. Joint Inst. for Aeronautics and Acoustics.
FOREBODY TANGENTIAL BLOWING FOR CONTROL AT HIGH ANGLES OF ATTACK Final Report
I. Kroo, S. Rock, and L. Roberts Jun. 1991 42 p
(Contract NCC2-55)
(NASA-CR-188773; NAS 1.26:188773; SU-JIAA-TR-101) Avail: NTIS HC/MF A03 CSCL 01C

A feasibility study to determine if the use of tangential leading edge blowing over the forebody could produce effective and practical control of the F-18 HARV aircraft at high angles of attack was conducted. A simplified model of the F-18 configuration using a vortex-lattice model was developed to obtain a better understanding of basic aerodynamic coupling effects and the influence of forebody circulation on lifting surface behavior. The effect of tangential blowing was estimated using existing wind tunnel data on normal forebody blowing and analytical studies of tangential blowing over conical forebodies. Incorporation of forebody blowing into the flight control system was investigated by adding this additional yaw control and sideforce generating actuator into the existing F-18 HARV simulation model. A control law was synthesized using LQG design methods that would schedule blowing rates as a function of vehicle sideslip, angle of attack, and roll and yaw rates. M.G.

N91-30153*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Facility, Edwards, CA.
MODELING, SIMULATION, AND FLIGHT CHARACTERISTICS OF AN AIRCRAFT DESIGNED TO FLY AT 100,000 FEET
Alex G. Sim Sep. 1991 44 p

(NASA-TM-104236; H-1731; NAS 1.15:104236) Avail: NTIS HC/MF A03 CSCL 01C

A manned real time simulation of a conceptual vehicle, the stratoplane, was developed to study the problems associated with the flight characteristics of a large, lightweight vehicle. Mathematical models of the aerodynamics, mass properties, and propulsion system were developed in support of the simulation and are presented. The simulation was at first conducted without control augmentation to determine the needs for a control system. The unaugmented flying qualities were dominated by lightly damped dutch roll oscillations. Constant pilot workloads were needed at high altitudes. Control augmentation was studied using basic feedbacks. For the longitudinal axis, flight path angle, and pitch rate feedback were sufficient to damp the phugoid mode and to provide good flying qualities. In the lateral directional axis, bank angle, roll rate, and yaw rate feedbacks were sufficient to provide a safe vehicle with acceptable handling qualities. Intentionally stalling the stratoplane to very high angles of attack (deep stall) was studied as a means of enable safe and rapid descent. It was concluded that the deep stall maneuver is viable for this class of vehicle. Author

N91-30154*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Facility, Edwards, CA.

APPLICATION AND FLIGHT TEST OF LINEARIZING TRANSFORMATIONS USING MEASUREMENT FEEDBACK TO THE NONLINEAR CONTROL PROBLEM

Robert F. Antoniewicz, Eugene L. Duke, and P. K. A. Menon (Georgia Inst. of Tech., Atlanta.) Sep. 1991 56 p

(NASA-TP-3154; H-1629; NAS 1.60:3154) Avail: NTIS HC/MF A04 CSCL 01C

The design of nonlinear controllers has relied on the use of detailed aerodynamic and engine models that must be associated with the control law in the flight system implementation. Many of these controllers were applied to vehicle flight path control problems and have attempted to combine both inner- and outer-loop control functions in a single controller. An approach to the nonlinear trajectory control problem is presented. This approach uses linearizing transformations with measurement feedback to eliminate the need for detailed aircraft models in outer-loop control applications. By applying this approach and separating the inner-loop and outer-loop functions two things were achieved: (1) the need for incorporating detailed aerodynamic models in the controller is obviated; and (2) the controller is more easily incorporated into existing aircraft flight control systems. An implementation of the controller is discussed, and this controller is tested on a six degree-of-freedom F-15 simulation and in flight on an F-15 aircraft. Simulation data are presented which validates this approach over a large portion of the F-15 flight envelope. Proof of this concept is provided by flight-test data that closely matches simulation results. Flight-test data are also presented. Author

N91-30155# National Aerospace Lab., Amsterdam (Netherlands). Informatics Div.

A GENERAL SIMULATION ENVIRONMENT FOR GUIDED WEAPON ANALYSIS

M. P. J. Cornelissen, H. B. M. Ellenbroek, and H. Kuiper 15 Mar. 1989 13 p Presented at 1989 Summer Computer Simulation Conference Sponsored by Royal Netherlands Air Force Directorate of Material

(NLR-TP-89084-U; ETN-91-99641) Avail: NTIS HC A03/MF A01

The simulation environment for guided weapon systems, developed in the MISAM (MISsile Analysis Models) project is considered. It is meant to overcome problems in guided weapon simulation, i.e., difficulties in reuse of existing models and use of those models by noncomputer specialists. The simulation environment is based on a structured breakdown of guided weapon systems, described in what is called the MISA handbook. This handbook contains guidelines for structuring simulation studies. The simulation environment supports model development and composition as well as simulation environment supports model development and composition as well as simulation preparation and execution. Attention is paid to the characteristics of a guided weapon model and the characteristics of the simulation to be carried out with that model. The development and use of the associated computer model are elucidated by the presentation of the first release of the implementation of the MISAM environment. ESA

N91-30156*# McDonnell Aircraft Co., Saint Louis, MO.

AEROSERVOELASTIC STABILIZATION TECHNIQUES FOR HYPERSONIC FLIGHT VEHICLES

Samuel Y. Chan, Peter Y. Cheng, Dale M. Pitt, Thomas T. Myers, David H. Klyde, Raymond E. Magdaleno, and Duane T. McRuer (Systems Technology, Inc., Hawthorne, CA.) Sep. 1991 95 p

(Contract NAS1-18763)

(NASA-CR-187614; NAS 1.26:187614) Avail: NTIS HC/MF A05 CSCL 01C

The potential of Hybrid Phase Stabilization (HPS), particularly for highly unstable aircraft, using a hypersonic flight vehicle (HSV) as a relevant example, is discussed. The development of HPS is presented and the result is compared with that generated using a conventional gain stabilization technique. Since HPS was not addressed in the MIL-spec requirements, a preliminary residual response metric was developed to provide guidance in assessing HPS. Author

09 RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands.

For related information see also *14 Ground Support Systems and Facilities (Space).*

N91-30157# Los Alamos National Lab., NM.

RADIO FREQUENCY (RF) HEATED SUPERSONIC FLOW LABORATORY

P. Wantuck and H. Watanabe 1990 18 p Presented at the 26th AIAA/SAE/ASME/ASEE Joint Propulsion Conference and Exhibit, Orlando, 16-18 Jul. 1990

(Contract W-7405-eng-36)

(DE90-012099; LA-UR-90-1523; CONF-900720-1) Avail: NTIS HC/MF A03

A unique supersonic flow apparatus which employs an inductively-coupled, radio frequency (RF) torch to supply high enthalpy source gas to the nozzle inlet is described. The main features of this system are the plasma tube, a cooled nozzle assembly, and a combustion/expansion chamber with a heat exchanger. A description of these components with current test data is presented. In addition, a discussion of anticipated experiments utilizing this system is included. DOE

N91-30158# Applied Research Associates, Inc., Aberdeen, MD. Research Center.

PROPOSED MODIFICATION OF THE JET FLOW FROM THE BRL 1.68-METER SHOCK TUBE Final Report, 1 Jun. 1990 - 18 Mar. 1991

Noel H. Ethridge May 1991 39 p

(Contract DAAA15-89-D-0008)

(AD-A236368; BRL-CR-664) Avail: NTIS HC/MF A03 CSCL 14/2

The jet from the open of the BRL 1.68-meter shock tube can produce high drag loading on a target with relatively little accompanying overpressure. This environment has characteristics resembling that of the non-ideal blast simulator. The flow from the tube has been used to overturn an item of military equipment. The jet from the tube is narrow. In this study, a small model of the tube with a steady-flow jet was used to examine the possibility of broadening and flattening the jet velocity profile. Several fixtures were built and attached to the end of the tube. These divided the flow into several jets directed to produce the desired jet

modifications at ten diameters from the end. A six-jet and ten-jet fixture produced acceptable modifications. A plan for development and testing for the BRL 1.68-meter tube was developed. GRA

N91-30159# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
DEVELOPMENT OF AN INCINERATOR FOR VISCOUS RESIDUES M.S. Thesis [DESENVOLVIMENTO DE UM INCINERADOR DE RESIDUOS PASTOSOS]
Francisco Carlos EliziodePaula Dec. 1990 79 p In PORTUGUESE; ENGLISH summary Original contains color illustrations
(INPE-5219-TDL/433) Avail: NTIS HC/MF A05

The results are presented of characterization of an incinerator for chemical process residues. A residue from benzoic acid distillation was utilized in the investigation. An incinerator was developed and tested for three residue feed rates: 5, 20, and 25 kg/h. Curves of CO and CO2 concentration, gas temperature, and residence times were evaluated for several air/fuel ratios. A gas cleaning device which was attached to the incinerator outlet was also developed and tested. Author

N91-30160 McMaster Univ., Hamilton (Ontario). Accelerator Lab.
A PRELIMINARY DEDICATED FACILITY FOR SINGLE EVENT UPSET (SEU) TESTING OF SEMICONDUCTOR COMPONENTS AT THE MCMASTER ACCELERATOR LABORATORY
J. C. Waddington and J. W. Stark 1989 33 p Sponsored by Defence Research Establishment
(CTN-91-60218) Avail: NTIS HC A03

A preliminary dedicated facility for single event upset (SEU) testing has been established at the McMaster University Accelerator Laboratory in Hamilton, Ontario. This facility has the capability of simulating more than 75 percent of the linear energy transfer particle (LET) spectrum that a satellite would encounter in Earth orbit. The radiation source is a tandem Van der Graaff accelerator. As a test for the facility, two semiconducting devices were selected for bombardment by a range of heavy ions at the facility. The inability to remove the encapsulation materials from the first device, a NEC /D41256C-12 DYNAMIC RAM memory, prevented its testing as the LETs were unable to penetrate the encapsulation. The ceramic encapsulation of the second device, a S RAM AM2167-70 DC chip, was removed and it was successfully tested. It was recommended that the target chamber be refined to allow rotation of the test device to allow simulation of flux incident from all directions. It was also recommended that techniques be developed for removing semiconductor packaging. CISTI

N91-30161*# Control Dynamics Co., Huntsville, AL.
MECHANISM TEST BED. FLEXIBLE BODY MODEL REPORT
Jimmy Compton Jul. 1991 118 p
(Contract NAS8-38771)
(NASA-CR-184189; NAS 1.26:184189) Avail: NTIS HC/MF A06 CSCL 14B

The Space Station Mechanism Test Bed is a six degree-of-freedom motion simulation facility used to evaluate docking and berthing hardware mechanisms. A generalized rigid body math model was developed which allowed the computation of vehicle relative motion in six DOF due to forces and moments from mechanism contact, attitude control systems, and gravity. No vehicle size limitations were imposed in the model. The equations of motion were based on Hill's equations for translational motion with respect to a nominal circular earth orbit and Newton-Euler equations for rotational motion. This rigid body model and supporting software were being refined. Author

N91-30162*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
SIMULATION OF TRANSIENT FLOW IN A SHOCK TUNNEL AND A HIGH MACH NUMBER NOZZLE Final Report
P. A. Jacobs Jul. 1991 16 p Submitted for publication
(Contract NAS1-18605)
(NASA-CR-187606; NAS 1.26:187606; ICASE-91-60) Avail: NTIS HC/MF A03 CSCL 14B

A finite volume Navier-Stokes code was used to simulate the shock reflection and nozzle starting processes in an axisymmetric shock tube and a high Mach number nozzle. The simulated nozzle starting processes were found to match the classical quasi-1-D theory and some features of the experimental measurements. The shock reflection simulation illustrated a new mechanism for the driver gas contamination of the stagnated test gas. Author

N91-30163*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
THE NASA LEWIS RESEARCH CENTER INTERNAL FLUID MECHANICS FACILITY
A. R. Porro, W. R. Hingst, C. A. Wasserbauer, and T. B. Andrews Sep. 1991 23 p
(NASA-TM-105187; E-6487; NAS 1.15:105187) Avail: NTIS HC/MF A03 CSCL 14B

An experimental facility specifically designed to investigate internal fluid duct flows is described. It is built in a modular fashion so that a variety of internal flow test hardware can be installed in the facility with minimal facility reconfiguration. The facility and test hardware interfaces are discussed along with design constraints of future test hardware. The plenum flow conditioning approach is also detailed. Available instrumentation and data acquisition capabilities are discussed. The incoming flow quality was documented over the current facility operating range. The incoming flow produces well behaved turbulent boundary layers with a uniform core. For the calibration duct used, the boundary layers approached 10 percent of the duct radius. Freestream turbulence levels at the various operating conditions varied from 0.64 to 0.69 percent of the average freestream velocity. Author

N91-30164# Aeritalia S.p.A., Turin (Italy). Centro di Simulazione.
ON-LINE ASSISTANCE IN FLIGHT SIMULATION
Michele Visciola, Armando Armand, and Sebastiano Bagnara (Siena Univ., Italy) 1990 11 p Presented at the 5th Societa Europa Ergonomia Cognitiva, Urbino, Italy, Sep. 1990
(ETN-91-99772) Avail: NTIS HC/MF A03

Preliminary results of an explorative investigation of modalities of assistance during a training stage in a flight simulator are presented. Assistance modalities and communication patterns are studied in order to find error detection and correction conditions. Ways to assist the pilot in avoiding erroneous decisions and actions well before they happen are investigated. Ten consistent patterns of communication between pilots and instructors are found. These patterns can be used in developing a framework for the design of a data bank which takes into account both error episodes and modalities of assistance in learning activities. ESA

N91-30165# European Space Agency, Paris (France).
STUDY OF AN ELECTROTHERMAL DE-ICER: NUMERICAL SIMULATION AND MEASUREMENT OF THE SKIN TEMPERATURE BY INFRARED TECHNIQUE IN AN ICING WIND TUNNEL Ph.D. Thesis - Clermont-Ferrand Univ., 1989
Robert Henry (Office National d'Etudes et de Recherches Aerospatiales, Paris, France) May 1991 211 p Transl. into ENGLISH of Etude du Fonctionnement d'un Degivreur Electrique Modelisation et Mesure en Soufflerie Givrante de Temperature Parietale par Thermographie Infrarouge (Paris, France, ONERA), Dec. 1989 Original language document was announced as N91-11133
(ESA-TT-1231; ONERA-NT-1989-10; ETN-91-99808) Avail: NTIS HC/MF A10

Various protective measures taken against ice formation are presented. The method of measurement using infrared thermography in an icing wind tunnel and the measurements actually carried out are described. Particular emphasis is placed on the preliminary studies needed for thermographic measurement. The results of the measurement led to the development of a new numerical model for deicing taking into account the melting of a

layer of ice. This model is described and compared with similar programs, as well as with a finite element program (ADIBAT). The results obtained experimentally with the infrared camera are compared with the numerical results arising from the developed program. This comparison reveals the present limitations of the model and possible improvements in it, such as taking into account the capture of droplets and the changes occurring in the ice layer. ESA

N91-30166 Institute for Perception RVO-TNO, Soesterberg (Netherlands). Visuology Group.
THE CONSTRUCTION OF A HIERARCHICAL MORPHOLOGICAL GRAPH FOR DATA FUSION Final Report
A. Toet and H. Couperus 29 Nov. 1990 23 p
(Contract A87/D/149)
(IZF-1990-A-38; TD-90-3414; ETN-91-99821) Copyright Avail: Institute for Perception RVO-TNO, P.O. Box 23, 3769 ZG Soesterberg, Netherlands

A hierarchical clustering method is presented. The elements of the original dataset and their intercorrelations are represented by nodes and edges between the nodes. This is called a graph representation. A description of a complex large graph as a union of simple connected subgraphs is obtained by link nodes between progressively nonlinearly (morphologically) filtered versions of the original graph. The resulting hierarchical clustering can be developed into an efficient tool for multisensor data fusion. ESA

N91-30167 Institute for Perception RVO-TNO, Soesterberg (Netherlands). Traffic Behavior Group.
PROPOSAL FOR A NEW PERFORMANCE EVALUATION AND FEEDBACK SYSTEM FOR THE LEOPARD 2 DRIVING SIMULATOR Final Report
J. E. Korteling 11 Dec. 1990 31 p
(Contract A89/KL/325)
(IZF-1990-A-40; TD-90-3417; ETN-91-99822) Copyright Avail: Institute for Perception RVO-TNO, P.O. Box 23, 3769 ZG Soesterberg, Netherlands

In order to improve the efficiency of the training of Leopard 2 drivers, the Leopard 2 driving simulator (Link Miles) is equipped with a Performance And Marking (PAM) System. Application of this system may increase the objectivity of performance evaluation by the instructors and enhance the quality of behavioral feedback to the student. Preliminary usage of this system, however, indicates that the system may not be capable of realizing these goals. Seven principles concerning the design of performance evaluation and feedback systems for training simulators are formulated. These principles refer to the validity of the simulator for different subtasks, the relevance of performance variables, the manner of performance measurement and of criterion construction, the comprehensibility of scores, and the ergonomics of data presentation. Based on these principles and a priori performed task analysis, the PAM system is criticized and a new Performance Evaluation and Feedback (PEF) system is proposed. This new PEF system is based on a selection of the nine most relevant subtasks each combined with critical and objective performance measures. Guidelines are provided for development, implementation, and usage of the system, calculation of scores, and data presentation. ESA

N91-30684# Joint Publications Research Service, Arlington, VA.
POSSIBILITIES OF USING FLIGHT SIMULATORS IN DYNAMIC MEDICAL OBSERVATION OF FLIGHT CREW Abstract Only
V. A. Bodrov *In its* JPRS Report: Science and Technology. USSR: Life Sciences 19 Feb. 1991 p 1 Transl. into ENGLISH from Voyenno-Meditsinskiy Zhurnal, Moscow (USSR), no. 11, Nov. 1989 p 51-55 (For primary document see N91-30683 22-52)
Avail: NTIS HC/MF A04

12 ASTRONAUTICS (GENERAL)

For extraterrestrial exploration see *91 Lunar and Planetary Exploration.*

N91-30168*# Aeritalia S.p.A., Naples (Italy). Space Systems Group.
TETHERED VARIABLE GRAVITY LABORATORY STUDY: LOW GRAVITY PROCESS IDENTIFICATION REPORT Final Report
M. Briccarello 28 Feb. 1989 72 p
(Contract NAS9-17877)
(NASA-CR-185613; NAS 1.26:185613) Avail: NTIS HC/MF A04 CSCL 22A

Experiments are described performable in the variable gravity environment, and the related compatible/beneficial residual accelerations, both for pure and applied research in the fields of Fluid Mechanics (static and dynamic), Materials Sciences (Crystal Growth, Metal and Alloy Solidification, Glasses, etc.), and Life Sciences, so as to assess the relevance of a variable G-level laboratory. Author

N91-30169# National Space Council, Washington, DC.
NATIONAL SPACE COUNCIL: 1990 REPORT TO THE PRESIDENT
4 Jan. 1991 38 p
(PB91-175976) Avail: NTIS HC/MF A03 CSCL 22A

This is the National Space Council 1990 Report to the President. The National Space Council carries out activities to integrate and coordinate civil, commercial, and national security space activities and has taken major steps toward their implementation. The Council's planning process consist of four phases: define broad goals and objectives for the U.S. space program; determine strategies to implement these goals and objectives; monitor the implementation of these strategies; and resolve specific issues that arise during the implementation process. Author

N91-30170# Joint Publications Research Service, Arlington, VA.
JPRS REPORT: SCIENCE AND TECHNOLOGY. USSR: SPACE
26 Jun. 1991 71 p Transl. into ENGLISH of various Russian articles
(JPRS-USP-91-003) Avail: NTIS HC/MF A04

Abstracts of Soviet literature in various areas of aerospace sciences are compiled. The following subject areas are covered: manned missions; space sciences; life sciences; space engineering; space applications; and space policy and administration. For individual titles, see N91-30171 through N91-30174.

N91-30171# Joint Publications Research Service, Arlington, VA.
COMMENTARY ON SALYUT-7 REENTRY, INTENDED ROLE OF COSMOS-1686-TYPE MODULES **c18**
B. Olesyuk *In its* JPRS Report: Science and Technology. USSR: Space 26 Jun. 1991 p 9-10 Transl. into ENGLISH from Trud, Moscow (USSR), 23 Jan. 1991 p 4 (For primary document see N91-30170 22-12)
Avail: NTIS HC/MF A04

It was reported that the Salyut-7 station linked-up with the Cosmos-1686 craft will make an uncontrolled reentry into dense layers of the atmosphere in February 1992, and a massive 3-ton capsule will fall to Earth. The history of the Salyut-7 mission is described. The reasons of the mission faults are discussed.
Author

N91-30172# Joint Publications Research Service, Arlington, VA.
RESULTS FROM STUDY OF X RAY PULSARS BY ASTRON OBSERVATORY **c89**
V. G. Kurt and Ye. Yu. Shafer *In its* JPRS Report: Science and Technology. USSR: Space 26 Jun. 1991 p 10-12 Transl. into ENGLISH from Zemlya i Vselennaya, Moscow (USSR), no. 6, Nov.-Dec. 1990 p 3-12 (For primary document see N91-30170 22-12)
Avail: NTIS HC/MF A04

X-ray pulsars, being neutron stars or, possibly, black holes, are being investigated intensively with ground-based and

spaceborne telescopes operating in the optical and x-radiation ranges. Valuable data on those stars were obtained from the Astron station, specialized astronomy satellite. Author

N91-30173# Joint Publications Research Service, Arlington, VA.
SOVIET PARTICIPATION IN FIFE-1989 REMOTE SENSING STUDY **c43**
A. M. Grin and V. V. Kozoderov *In its* JPRS Report: Science and Technology. USSR: Space 26 Jun. 1991 p 24-27 Transl. into ENGLISH from Priroda, Moscow (USSR), no. 12, Dec. 1990 p 60-65 (For primary document see N91-30170 22-12)
Avail: NTIS HC/MF A04

In the summer of 1989, a group of Soviet specialists participated in the FIFE-1989 field experiment. Their objective was to obtain data for the interpretation of satellite observations of the condition of the land surface. The results of this work are presented and discussed. The data obtained in the FIFE-1989 experiment make it possible to approximate a reliable estimate of the state of the Earth's surface from remote sensing data, which is quite significant in the organization of space monitoring. Author

N91-30174# Joint Publications Research Service, Arlington, VA.
GALEYEV DISCUSSES HISTORY, PROSPECTS OF INSTITUTE OF SPACE RESEARCH **c99**
Albrrt Abubakirovich Galeyev *In its* JPRS Report: Science and Technology. USSR: Space 26 Jun. 1991 p 34-39 Transl. into ENGLISH from Zemlya i Vselennaya, Moscow (USSR), Nov.-Dec. 1990 p 38-45 (For primary document see N91-30170 22-12)
Avail: NTIS HC/MF A04

The research activities at the USSR Academy of Sciences Space Research Institute are discussed. It became the head organization in the field of scientific research involving space, the solar system's planets, and astrophysical objects. It was entrusted with preparing and supporting programs for space research, developing, testing, and using scientific equipment for that research, and ensuring international cooperation in the performance of experiments in space. Author

N91-30175*# Boeing Aerospace Co., Huntsville, AL. Advanced Civil Space Systems.
SPACE TRANSFER CONCEPTS AND ANALYSIS FOR EXPLORATION MISSIONS Final Report
Mar. 1991 109 p
(Contract NAS8-37857)
(NASA-CR-184178; NAS 1.26:184178; D615-10031-1) Avail: NTIS HC/MF A06 CSCL 22A

A broad scoped and systematic study was made of space transfer concepts for human Lunar and Mars missions. Relevant space transportation studies were initiated to lead to further detailed activities in the following study period. Author

N91-30176# Norwegian Space Center, Oslo.
[ACTIVITIES REPORT OF THE NORWEGIAN SPACE CENTER] Annual Report, 1989 [NORSK ROMSENTER, AARSBERETNING 1989]
1989 19 p In NORWEGIAN
(ETN-91-98904) Avail: NTIS HC/MF A03

An overview of the contribution of the Norwegian Space Center to 1989 space activities is presented. A summary table of cost breakdown is given with the 1988 figures given as comparison. Contributions to telecommunication systems, the Columbus Space Station, hypersonic space transport (including the West German Saenger vehicle), remote sensing observation and the Cassini/Huygen mission are outlined. An administration graphic of the center is included. ESA

13 ASTRODYNAMICS

Includes powered and free-flight trajectories; and orbital and launching dynamics.

N91-30177*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
TRAJECTORIES OF INNER AND OUTER HELIOSPHERIC SPACECRAFT: PREDICTED THROUGH 1999
R. Parthasarathy (ST Systems Corp., Greenbelt, MD.) and Joseph H. King Mar. 1991 25 p
(NASA-TM-105041; NSSDC/WDC-A-R/S-91-08; NAS 1.15:105041) Avail: NTIS HC/MF A03 CSCL 22A

Information is presented in tabular and graphical form on the trajectories of the international fleet of spacecraft that will be probing the far reaches of the heliosphere during the 1990s. In particular, the following spacecraft are addressed: Pioneer 10 and 11, Pioneer Venus Orbiter (PVO), Voyager 1 and 2, Galileo, Ulysses, Suisei, Sakigake, Giotto, International Cometary Explorer (ICE), and Interplanetary Monitoring Platform 8 (IMP 8). Yearly resolution listing of position information in inertial space are given for Pioneer and Voyager spacecraft from the times of their launches in the 1970s. One series of plots shows the radial distances, latitudes, and longitudes of the Pioneers and Voyagers. The solar ecliptic inertial coordinate system is used. In this system, the Z axis is normal to the ecliptic plane and the X axis is towards the first point of Aries (from Sun to Earth on the vernal equinox). Author

N91-30178 Stanford Univ., CA.
A CLOSED LOOP GPS-BASED ORBIT TRIM SYSTEM FOR GRAVITY PROBE B Ph.D. Thesis
Penina Axelrad 1991 157 p
Avail: Univ. Microfilms Order No. DA9115737

An onboard closed loop navigation and control system capable of executing extremely precise orbit maneuvers is described. In particular, a system to adjust the orbit of the Gravity Probe B (GP-B) spacecraft is presented. This onboard system relies on the Global Positioning System (GPS) to provide navigation information directly to the vehicle, thus alleviating the need for ground support. GP-B is a NASA project to measure two relativistic effects on orbiting gyroscopes to an unprecendented accuracy. The ideal orbit is circular, polar, and contains the line of sight to a guide star which serves as a distant inertial reference. The target injection orbit is specified based on orbit modeling over the entire 18 month mission, in order to best satisfy the ideal conditions on average. The perturbing effects of the geopotential, the Sun and the Moon, and other forces on the orbit are considered. Simulations show that the target inclination must be achieved to an accuracy of 2 x 10(exp -4) deg (25 m) to satisfy the experiment goals. The design of a GPS based navigation system and onboard orbit trim system is presented. The role of the navigation system is to provide an estimate of the satellite position and velocity state to the control system in a form that can be used to determine the necessary orbit adjustments. Two types of GPS receivers are considered: a high quality, dual frequency receiver capable of eliminating the effects of Selective Availability (SA), and a lower accuracy variety which is subjected to SA level errors. The objective of the trim system is to achieve the target state in minimum time. Dissert. Abstr.

N91-30179# Colorado Univ., Boulder. Center for Astrodynamics Research.
A COVARIANCE STUDY FOR ORBIT ACCURACY IMPROVEMENT OF THE GPS SATELLITES USING FIBER OPTICS TRACKING
William S. Schreiner 1991 6 p
(Contract N00014-90-J-2010)
(AD-A237858) Avail: NTIS HC/MF A02 CSCL 17/7

Presented here is an alternative Global Positioning System (GPS) orbit determination system that consists of a relatively closely spaced tracking network that is time and frequency synchronized by a fiber optic link. The proposed fiber optic tracking system is described. Preliminary results of a covariance study are presented that indicate the possibility of achieving sub meter on-orbit

accuracy. The covariance analysis was completed with the Orbit Analysis Simulation Software (OASIS), which was developed at the Jet Propulsion Laboratory (JPL). Author

N91-30180# Colorado Univ., Boulder. Center for Astrodynamics Research.
SALT ORBIT DETERMINATION COVARIANCE ANALYSIS USING GPS TRACKING
Kristine Larson, Scott Pogorele, George Born, and Peter MacDoran 15 Jun. 1991 17 p
(Contract N00014-90-J-2010)
(AD-A237899) Avail: NTIS HC/MF A03 CSCL 17/7

In addition to hosting an altimeter for oceanographic measurements, the SALT satellite was also to carry on board a light-weight, 2-channel GPS receiver. Results of a covariance analysis of the radial precision of non-real-time GPS-derived SALT orbits are presented. For comparison, solutions were also computed for a GPS receiver similar to the one which will be launched on Topex. Author

N91-30181*# Dynetics, Inc., Huntsville, AL.
ATTITUDE PROFILE DESIGN PROGRAM Final Report
Jan. 1991 64 p
(Contract NAS8-37850)
(NASA-CR-184183; NAS 1.26:184183; TR-91-NASA-37850-004)
Avail: NTIS HC/MF A04 CSCL 22A

The Attitude Profile Design (APD) Program was designed to be used as a stand-alone addition to the Simplex Computation of Optimum Orbital Trajectories (SCOOT). The program uses information from a SCOOT output file and the user defined attitude profile to produce time histories of attitude, angular body rates, and accelerations. The APD program is written in standard FORTRAN77 and should be portable to any machine that has an appropriate compiler. The input and output are through formatted files. The program reads the basic flight data, such as the states of the vehicles, acceleration profiles, and burn information, from the SCOOT output file. The user inputs information about the desired attitude profile during coasts in a high level manner. The program then takes these high level commands and executes the maneuvers, outputting the desired information. Author

N91-30182# Royal Aerospace Establishment, Farnborough (England).
PERTURBATIONS, UNTRUNCATED IN ECCENTRICITY, FOR AN ORBIT IN AN AXI-SYMMETRIC GRAVITATIONAL FIELD
R. H. Gooding 6 Mar. 1991 28 p Repr. from Adv. Astrnonaut. Sci., v. 71, 1990 p 1229-1250 Presented at AAS/AIAA Astrodynamics Specialist Conference, Stowe, VA, 1989 Previously announced in IAA as A90-46825
(RAE-TM-Space-379; BR300701; ETN-91-99850) Copyright
Avail: NTIS HC/MF A03

By recourse to a particular definition of a satellite's mean orbital element and to a particular system of spherical polar coordinates based on the mean orbital plane, an orbital theory was developed that leads to extremely compact first order perturbation formulae associated with the general zonal harmonic, J(sub l). The formulae are complete (untruncated in eccentricity) and generalize, via recurrence relations, the author's earlier results for the effects of J(sub 2) (analyzed to second order) and J(sub 3). To illustrate the compact nature of individual expressions, the (untruncated) perturbation formulae due to J(sub 4) are given. ESA

N91-30183# Royal Aerospace Establishment, Farnborough (England).
ON THE UNIVERSALITY OF ORBITAL THEORY FOR SATELLITE MOTION PERTURBED BY GRAVITATIONAL HARMONICS
R. H. Gooding 6 Mar. 1991 10 p Repr. from Advances in Space Research, v. 11, 1991 p 167-170 Presented at the 28th Cospar Plenary Meeting, The Hague, Netherlands, 8 Jul. 1990 Previously announced in IAA as A91-47647
(RAE-TM-Space-380; BR300629; ETN-91-99851) Copyright
Avail: NTIS HC/MF A02

An orbital theory for the motion of a satellite in a gravitational field is considered. The author's approach to perturbation analysis for a satellite orbiting in a general gravitational field, concisely formulated by the use of a particular system of spherical polar coordinates, was conceived as applying only to elliptic orbits. However, the formulation extends, with surprising ease, to hyperbolic orbits. No change is required in the manner in which some perturbations are applied to the orbital elements and others to the coordinates, though it becomes purely conventional to describe the coordinate perturbations as short periodic. ESA

N91-30184# Royal Aerospace Establishment, Farnborough (England).
UNTRUNCATED PERTURBATION ANALYSIS FOR A SATELLITE ORBITING IN A NON-ROTATING GRAVITATIONAL FIELD
R. H. Gooding 6 Mar. 1991 16 p Presented at the AIAA/AAS Astrodynamics Specialist Conference, Portland, OR, 20 Aug. 1990 Previously announced in IAA as A90-52959
(RAE-TM-Space-381; BR300631; ETN-91-99852) Copyright
Avail: NTIS HC/MF A03

In previous work it was assumed that the gravitational field was axisymmetric and due to a mass distribution entirely within the orbital region. By use of a particular system of spherical polar coordinates, an orbital theory was developed that led to compact first order perturbation formulae associated with the general zonal harmonic, J(sub l). No eccentricity truncation was involved in these formulae, though there was an implicit restriction to elliptic orbits. The theory has now been given a logical completeness by three distinct extensions: by allowing for tesseral harmonics, J(sub lm), the assumption of axial symmetry can be dropped; by permitting the harmonic index, l, to be negative, mass outside the orbital region can be allowed for; and the formulae can be so expressed that hyperbolic orbits are covered. The extensions are straightforward so long as the field is still assumed to be time invariant, ie to be nonrotating, and this assumption is made. The second extension involved the most new work, since the plantary equations have to be formulated with the eccentric anomaly as integration variables when l less than 0. It is still possible to express the short-period perturbations in terms of true anomaly, however. ESA

N91-30185# Royal Aerospace Establishment, Farnborough (England).
ON A PROBLEM ARISING IN THE COMPUTATION OF ORBIT PERTURBATIONS
R. H. Gooding 22 May 1991 12 p
(RAE-TM-Space-384; BR302518; ETN-91-99892) Copyright
Avail: NTIS HC/MF A03

In the computation of perturbations for an orbiting satellite, a problem can arise with the integration of a rate of change quantity, the prototype expression for which is k cos theta, where theta has a quasi linear variation with time. The problem can be dealt with by the use of definite integrals between epochs rather than indefinite integrals at epochs. ESA

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and simulators.

For related information see also *09 Research and Support Facilities (Air).*

N91-30186*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
POWER SYSTEMS TESTING
Aug. 1991 17 p Original contains color illustrations
(NASA-TM-104513; E-6383; NAS 1.15:104513) Avail: NTIS HC/MF A03; 11 functional color pages CSCL 14B

The Space Station Freedom (SSF) will give the U.S. a

permanent manned presence in space in 1999. The SSF underwent its final design concept in 1991. Launches of hardware will begin in late 1995, and the SSF will become operational in the man tended configuration in 1997. Additional Space Shuttle flights between 1997 and 1999 will complete the SSF. Along with international partners, a crew of four astronauts will conduct long-term experimentation in the microgravity environment of the orbiting spacecraft. Lewis Research Center, along with its prime contractor, will provide the electrical power system (EPS) for SSF. Two major testing facilities at the Lewis Research Center will support the Lewis EPS. The Power Systems Facility provides test beds for life testing the station batteries and the power management distribution system testbed. This testbed simulates two channels of the EPS. The Space Power Facility at the Lewis Plum Brook Station is the largest vacuum chamber in the world. Within this chamber, a simulated space environment, testing of full-size EPS components will occur. Author

15 LAUNCH VEHICLES AND SPACE VEHICLES

Includes boosters; operating problems of launch/space vehicle systems; and reusable vehicles.

For related information see also *20 Spacecraft Propulsion and Power.*

N91-30187*# Boeing Aerospace and Electronics Co., Seattle, WA.
CONCEPTUAL DESIGNS STUDY FOR A PERSONNEL LAUNCH SYSTEM (PLS) Final Report, 23 Oct. 1989 - 1 Dec. 1990
E. D. Wetzel 1 Dec. 1990 581 p
(Contract NAS9-18255)
(NASA-CR-185647; NAS 1.26:185647) Avail: NTIS HC/MF A25 CSCL 22D

A series of conceptual designs for a manned, Earth to Low Earth Orbit transportation system was developed. Non-winged, low L/D vehicle shapes are discussed. System and subsystem trades emphasized safety, operability, and affordability using near-term technology. The resultant conceptual design includes lessons learned from commercial aviation that result in a safe, routine, operationally efficient system. The primary mission for this Personnel Launch System (PLS) would be crew rotation to the SSF; other missions, including satellite servicing, orbital sortie, and space rescue were also explored. Author

16 SPACE TRANSPORTATION

Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques.

For related information see also *03 Air Transportation and Safety* and *18 Spacecraft Design, Testing and Performance.* For space suits see *54 Man/System Technology and Life Support.*

N91-30188*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
STS-35 SCRUB 3 HYDROGEN LEAK ANALYSIS
Dave Seymour Jul. 1991 73 p
(NASA-TM-103548; NAS 1.15:103548) Avail: NTIS HC/MF A04 CSCL 22B

During the summer of 1990, space shuttle Columbia experienced both an external tank/orbiter disconnect hydrogen leak and multiple internal aft compartment hydrogen leaks. After the third scrub of STS-35, a leak investigation team was organized. In support of this team, an analysis of the data obtained during scrub 3 was performed. Based on this analysis, the engine 2 prevalve was concluded to be the most likely leak location and to account for most of the observed leakage. Author

N91-30189# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany, F.R.). Hauptabt. Systemanalyse Raumfahrt.
PARAMETRIC EVALUATION OF THE SELECTION CRITERIA OF SPACE TRANSPORTATION SYSTEMS Ph.D. Thesis - Stuttgart Univ.
Dieter M. Wolf Jan. 1991 121 p In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-1265)
(DLR-FB-91-01; ISSN-0939-2963; ETN-91-99790) Avail: NTIS HC/MF A06; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 43 DM

An evaluation of space transportation systems is presented. The sensitivity of 18 launch vehicles is evaluated with respect to parametric variations. Vehicles considered are fully reusable single stage and two stage systems with different propulsion concepts and horizontal or vertical takeoff mode. The influences of alternative mass models, significant geometry parameters and number of installed engines are investigated as well as the reactions of the vehicles to modified assumptions like structure technology or payload capacity. The analyses are performed by using statistical analytical mass and cost estimation models. To determine the influences of parametric variations, the 18 launch vehicles are compared. With respect to the ratio of dry mass to payload mass, the influence of the resulting ranking of the single stage and the two stage vehicles is significant, provided that the design instructions are applied to all vehicles alike. The result is independent from dry mass changes caused by alternative mass models of the modification of geometric parameters. The same results are obtained for vehicles with modified structure technology and modified payload capacity, respectively. Only in the case that the design instructions are not applied uniformly, the ranking of the vehicles can be changed completely. Threfore, the models of space transportation systems, within a certain framework, appear to be reliable. ESA

17 SPACE COMM., SPACECRAFT COMM., COMMAND & TRACKING

Includes telemetry; space communications networks; astronavigation and guidance; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications and Radar.*

N91-30190# RMS Technologies, Inc., Lexington, MA.
CRRES PROJECT ORBITAL DATA PROCESSING TASK Final Report, 7 Jan. 1987 - 30 Sep. 1990
Eben Hiscock, Robert Rose, and Stephen Mehalek 20 Dec. 1990 85 p
(Contract F19628-87-C-0031)
(AD-A234286; PL-TR-91-2023) Avail: NTIS HC/MF A05 CSCL 12/5

This report discusses the design, development, and implementation of telemetry processing techniques and computational routines for processing large volumes of data telemetered from space probes. The emphasis is centered on the Combined Release and Radiation Effects Satellite (CRRES) Orbital Data Processing (ODP) System which was designed, developed, and is presently being implemented in support of the CRRES Program. It must also be noted that the requirement was for the system to be generic in design. The CRRES ODP System meets this requirement. The CRRES ODP System software programs were written using FORTRAN 5 language conforming to the American National Standards Institute (ANSI) FORTRAN 77 language standard X3.9-1978. This provides transportability to any ANSI standard system. GRA

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and attitude controls.

For life support systems see *54 Man/System Technology and Life Support.* For related information see also *05 Aircraft Design, Testing and Performance, 39 Structural Mechanics,* and *16 Space Transportation.*

N91-30191*# National Aeronautics and Space Administration, Washington, DC.
SPACE STATION WORKSHOP COMMERCIAL MISSIONS AND USER REQUIREMENTS: ISSUES AND RECOMMENDATIONS
12 May 1988 64 p Workshop held in Nashville, TN, 3-5 Nov. 1987
(NASA-TM-105093; NAS 1.15:105093) Avail: NTIS HC/MF A04 CSCL 22B

The issues and recommendations of a conference on the Space Station are presented. The subjects are organized under three headings of: materials and processing in space, earth and ocean observations, and industrial services. One hundred and two issues and recommendations which resulted from the workskop are categorized for each discipline subpanel. Responses to these issues and recommendations are based on more than twenty interviews with highly qualified NASA personnel and represent the best answers available at this time. M.G.

N91-30192*# National Aeronautics and Space Administration, Washington, DC.
SPACE STATION FREEDOM WORKSHOP OPPORTUNITIES FOR COMMERCIAL USERS AND PROVIDERS: ISSUES AND RECOMMENDATIONS
Jul. 1989 88 p Workshops held in Denver, CO, 25-28 Oct. 1988 and Nashville, TN, 3-5 Nov. 1987 Revised
(NASA-TM-105094; NAS 1.15:105094) Avail: NTIS HC/MF A05 CSCL 22B

The responses to issues and questions raised at the Space Station Freedom Workshops are compiled. The findings are presented under broad divisions of general, materials processing in space, commercial earth and ocean observations, life sciences, infrastructure services, and infrastructure policy. The responses represent the best answers available at this time and future modifications may be expected. Contact names, telephone numbers, and organizations are included. M.G.

N91-30193# Oklahoma Univ., Norman. Dept. of Mathematics.
ESTIMATION OF ELASTIC PARAMETERS IN LINEAR AND NONLINEAR DISTRIBUTED MODELS OF PLATES ARISING IN LARGE FLEXIBLE SPACE STRUCTURES Final Report, 30 Sep. 1987 - 29 Oct. 1990
Luther W. White Oct. 1990 26 p
(Grant AF-AFOSR-0368-87)
(AD-A229527; AFOSR-90-1158TR) Avail: NTIS HC/MF A03 CSCL 12/1

During the period covered by the grant over 20 research articles were written. Titles include: Identification of Cauchy Data in Nonlinear First Order Hyperbolic Systems, Control of Certain Dynamic Models of Beams and Plates, Identification of Elastic Parameters in von Karman Plate Models, and Identification of a Coefficient of Conductivity from Potential Measurements. GRA

N91-30194*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
THERMAL CONTROL SURFACES EXPERIMENT FLIGHT SYSTEM PERFORMANCE
Donald R. Wilkes, Leigh L. Hummer (AZ Technology, Huntsville, AL.), and James M. Zwiener 1991 45 p
(NASA-TM-105036; NAS 1.15:105036) Avail: NTIS HC/MF A03 CSCL 22B

The Thermal Control Surfaces Experiment (TCSE) is the most complex system, other than the LDEF, retrieved after long term space exposure. The TCSE is a microcosm of complex electro-optical payloads being developed and flow by NASA and the DoD including SDI. The objective of TCSE was to determine the effects of the near-Earth orbital environment and the LDEF induced environment on spacecraft thermal control surfaces. The TCSE was a comprehensive experiment that combined in-space measurements with extensive post flight analyses of thermal control surfaces to determine the effects of exposure to the low earth orbit space environment. The TCSE was the first space experiment to measure the optical properties of thermal control surfaces the way they are routinely measured in a lab. The performance of the TCSE confirms that low cost, complex experiment packages can be developed that perform well in space. Author

N91-30195*# Martin Marietta Aerospace, Denver, CO. Astronautics Group.
SPACE STATION AUTOMATION OF COMMON MODULE POWER MANAGEMENT AND DISTRIBUTION Interim Final Report
W. Miller, E. Jones, B. Ashworth, J. Riedesel, C. Myers, K. Freeman, D. Steele, R. Palmer, R. Walsh, and J. Gohring et al Washington NASA Nov. 1989 550 p
(Contract NAS8-36433)
(NASA-CR-4260; NAS 1.26:4260; MCR-89-516) Avail: NTIS HC/MF A23 CSCL 22B

The purpose is to automate a breadboard level Power Management and Distribution (PMAD) system which possesses many functional characteristics of a specified Space Station power system. The automation system was built upon 20 kHz ac source with redundancy of the power buses. There are two power distribution control units which furnish power to six load centers which in turn enable load circuits based upon a system generated schedule. The progress in building this specified autonomous system is described. Automation of Space Station Module PMAD was accomplished by segmenting the complete task in the following four independent tasks: (1) develop a detailed approach for PMAD automation; (2) define the software and hardware elements of automation; (3) develop the automation system for the PMAD breadboard; and (4) select an appropriate host processing environment. Author

N91-30196 California Univ., Los Angeles.
DESPIN OF A DUAL-SPIN SPACECRAFT WITH LIMITED TORQUE: PASSAGE THROUGH PRECESSION PHASE LOCK RESONANCE Ph.D. Thesis
Robert John Kinsey 1991 192 p
Avail: Univ. Microfilms Order No. DA9115435

This research pertains to two mechanical systems in which an unbalanced rotor must spin up through a system resonant frequency under the action of a motor with limited torque capability. The first system is a dual-spin spacecraft (s/c) with a dynamically unbalanced rotor. The second is a mathematically similar spring-mass oscillator with an embedded unbalanced rotor, which is referred to as an unbalanced oscillator. In each system, a stalling of the spinup process can occur during which the rotor rate is captured near the resonant frequency. Whether capture or spinup through resonance occurs depends on unbalance size relative to motor torque capability. The primary focus is on precession phase lock (PPL), one of three types of capture phenomena which can occur in a dual-spin s/c undergoing platform despin (and rotor spinup). PPL occurs when the magnitude of the despin motor torque is small relative to size of the rotor dynamic unbalance. During PPL, the rotor motion becomes synchronized with the free precession of the s/c, and a large secular deviation in attitude occurs. Results pertain to two different strategies for rotor spinup: using constant torque, and using closed loop feedback control. For the s/c using constant torque, a method is developed for estimating the mean cone angle following rotor spinup through PPL (and platform despin). The method involves simple hand calculations and provides estimates within 10 percent of true values. For the unbalanced oscillator, a simple formula is derived which accurately predicts the minimum constant torque required to achieve spinup through resonance, as a function of unbalance

size. The feedback control strategy is analytically derived and numerically verified. It exploits the pendulum-like behavior of each system during resonance. Dissert. Abstr.

N91-30197# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
ANALYSIS OF THE DYNAMICS AND CONTROL OF AN ARTIFICIAL SATELLITE WITH EXTENDABLE SOLAR ARRAYS M.S. Thesis - 20 Nov. 1990 [ANALISE DINAMICA E CONTROLE DE UM SATELITE ARTIFICIAL COM PAINEIS SOLARES FLEXIVEIS]
Alexandre MegiorinRoma Mar. 1991 197 p In PORTUGUESE; ENGLISH summary
(INPE-5220-TDL/436) Avail: NTIS HC/MF A09

Presented here is a systematic way to derive the equations of attitude motion for a particularly important class of spacecraft: those composed of a central rigid body containing reaction wheels, also assumed to be rigid, and extendable solar arrays, which are considered flexible only after the deployment phase. A Lagrangian formulation is used simultaneously with the Assumed Modes Method to avoid a hybrid set of equations of motion. Software employing the symbolic manipulator Reduce is developed to obtain, in some cases, these equations. With this software, the nonlinear set of equations for the transient deployment phase and the linearized set of equations for the next phase, including panel flexibility, is derived for a satellite used as an example. For this satellite, the transient phase is analyzed. Dyadic changes in time and attitude motion induced by the deployment of the panels is observed. In this case, the impact between the central body and each panel is introduced. For a linearized set of equations of motion, a control design, employing the Eigenstructure Assignment technique is implemented, stabilizing the attitude motion and damping the elastic vibrations. Author

N91-30198# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Materials and Processes Div.
THE CONTROL OF LIMITED-LIFE MATERIALS
Dec. 1990 14 p
(ESA-PSS-01-722-Issue-2; ISSN-0379-4059; ETN-91-99828)
Copyright Avail: NTIS HC/MF A03

The procedure to be used for the control of limited life materials employed in the fabrication of ESA spacecraft and associated equipment is specified. The areas covered are hazards and safety precautions, material control, procurement documents, identification, storage and handling. Control of material life includes assessment of shelf life, extension of shelf life and disposal of non certifiable materials. Acceptance criteria and recertification testing are outlined. Quality control criteria concerning data nonconformance, calibration and traceability are discussed. ESA

N91-30199# National Aerospace Lab., Amsterdam (Netherlands). Space Systems/Informatics Div.
EFFECTS OF LOW BOND NUMBER LIQUID MOTIONS ON SPACECRAFT ATTITUDE
J. P. B. Vreeburg and R. F. vandenDam 1989 18 p Presented at AGARD Flight Mechanics Panel Symposium on Space Vehicle Flight Mechanics, Luxembourg, 13-16 Nov. 1989 Previously announced as N90-27768
(NLR-TP-89352-U; ETN-91-99646) Avail: NTIS HC/MF A03

A review of the effects that onboard liquid may have on the dynamics of the spacecraft is given. A distinction is made between arbitrarily moving craft and spin stabilized vehicles. The modeling of rotating liquid behavior is very complicated and generally allows only predictions on the stability behavior of a spinning spacecraft. A flight experiment with a model satellite with liquid in an annular tank, during parabolic aircraft flight is described. From a filmed record of the unconstrained motion, the attitude of the satellite is reconstructed. Details of the image processsing scheme are given. The numerical simulation of the motion of the model satellite is explained. The liquid is inviscid and is assumed to move in the tank in two directions only, i.e., radial motion, is neglected. Surface tension effects are important and are fully accounted for. The angular rates of the model following a short duration torque, are presented. Plots of the liquid motion are included. ESA

N91-30171# Joint Publications Research Service, Arlington, VA.
COMMENTARY ON SALYUT-7 REENTRY, INTENDED ROLE OF COSMOS-1686-TYPE MODULES
B. Olesyuk *In its* JPRS Report: Science and Technology. USSR: Space 26 Jun. 1991 p 9-10 Transl. into ENGLISH from Trud, Moscow (USSR), 23 Jan. 1991 p 4 (For primary document see N91-30170 22-12)
Avail: NTIS HC/MF A04

N91-30237*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
LEO MICROMETEORITE/DEBRIS IMPACT DAMAGE
Paul M. Stella *In* NASA. Lewis Research Center, Space Photovoltaic Research and Technology Conference Aug. 1991 7 p (For primary document see N91-30203 22-20)
Avail: NTIS HC/MF A20 CSCL 22B

19 SPACECRAFT INSTRUMENTATION

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography.*

N91-30200*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
PRELIMINARY CALIBRATION PLAN FOR THE ADVANCED PARTICLES AND FIELD OBSERVATORY (APAFO) MAGNETOMETER EXPERIMENT
C. V. Voorhies, R. A. Langel, J. Slavin, E. R. Lancaster, and S. Jones (ST Systems Corp., Lanham, MD.) Washington Jul. 1991 83 p
(NASA-TM-104545; NAS 1.15:104545; Rept-91B00119) Avail: NTIS HC/MF A05 CSCL 14B

Prelaunch and postlaunch calibration plans for the APAFO magnetometer experiment are presented. A study of tradeoffs between boom length and spacecraft field is described; the results are summarized. The prelaunch plan includes: calibration of the Vector Fluxgate Magnetometer (VFM), Star Sensors, and Scalar Helium Magnetometer (SHM); optical bench integration; and acquisition of basic spacecraft field data. Postlaunch calibration has two phases. In phase one, SHM data are used to calibrate the VFM, total vector magnetic field data are used to calibrate a physical model of the spacecraft field, and both calibrations are refined by iteration. In phase two, corrected vector data are transformed into geocentric coordinates, previously undetected spacecraft fields are isolated, and initial geomagnetic field models are computed. Provided the SHM is accurate to the required 1.0 nT and can be used to calibrate the VFM to the required 3.0- nT accuracy, the tradeoff study indicates that a 12 m boom and a spacecraft field model uncertainty of 5 percent together allow the 1.0 nT spacecraft field error requirement to be met. Author

20 SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxilliary power sources.

For related information see also *07 Aircraft Propulsion and Power, 28 Propellants and Fuels, 44 Energy Production and Conversion,* and *15 Launch Vehicles and Space Vehicles.*

N91-30201*# Sverdrup Technology, Inc., Brook Park, OH.
A PRELIMINARY CHARACTERIZATION OF APPLIED-FIELD MPD THRUSTER PLUMES Final Report
Roger M. Myers, David Wehrle, Mark Vernyi, James Biaglow, and Shawn Reese (Ohio Univ., Athens.) Aug. 1991 37 p Presented at the 27th Joint Propulsion Conference, Sacramento, CA, 24-27

Jun. 1991; cosponsored by AIAA, SAE, ASME, and ASEE
(Contract NAS3-25266)
(NASA-CR-187165; E-6426; NAS 1.26:187165; AIAA-91-2339)
Avail: NTIS HC/MF A03 CSCL 21H

Electric probes, quantitative imaging, and emission spectroscopy were used to study the plume characteristics of applied field magnetohydrodynamic thrusters. The measurements showed that the applied magnetic field plays the dominant role in establishing the plume structure, followed in importance by the cathode geometry and propellant. The anode radius had no measurable impact on the plume characteristics. For all cases studied the plume was highly ionized, though spectral lines of neutral species were always present. Centerline electron densities and temperatures ranged from 2 times 10 (exp 18) to 8 times 10 (exp 18) m(exp -3) and from 7500 to 20,000 K, respectively. The plume was strongly confined by the magnetic field, with radial density gradients increasing monotonically with applied field strength. Plasma potential measurements show a strong effect of the magnetic field on the electrical conductivity and indicate the presence of radial current conduction in the plume. Author

N91-30202*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
MICROANALYSIS OF EXTENDED-TEST XENON HOLLOW CATHODES
Timothy R. Verhey (Sverdrup Technology, Inc., Brook Park, OH.) and Michael J. Patterson 1991 49 p Presented at the 27th Joint Propulsion Conference, Sacramento, CA, 24-27 Jun. 1991; cosponsored by AIAA, SAE, ASME, and ASEE
(NASA-TM-104532; E-6408; NAS 1.15:104532; AIAA-91-2123)
Avail: NTIS HC/MF A03 CSCL 21H

Four hollow cathode electron sources were analyzed via boroscopy, scanning electron microscopy, energy dispersive x ray analysis, and x ray diffraction analysis. These techniques were used to develop a preliminary understanding of the chemistry of the devices that arise from contamination due to inadequate feed-system integrity and improper insert activation. Two hollow cathodes were operated in an ion thruster simulator at an emission current of 23.0 A for approximately 500 hrs. The two tests differed in propellant-feed systems, discharge power supplies, and activation procedures. Tungsten deposition and barium tungstate formation on the internal cathode surfaces occurred during the first test, which were believed to result from oxygen contamination of the propellant feed-system. Consequently, the test facility was upgraded to reduce contamination, and the test was repeated. The second hollow cathode was found to have experienced significantly less tungsten deposition. A second pair of cathodes examined were the discharge and the neutralizer hollow cathodes used in a life-test of a 30-cm ring-cusp ion thruster at a 5.5 kW power level. The cathodes' test history was documented and the post-test microanalyses are described. The most significant change resulting from the life-test was substantial tungsten deposition on the internal cathode surfaces, as well as removal of material from the insert surface. In addition, barium tungstate and molybdate were found on insert surfaces. As a result of the cathode examinations, procedures and approaches were proposed for improved discharge ignition and cathode longevity. Author

N91-30203*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
SPACE PHOTOVOLTAIC RESEARCH AND TECHNOLOGY CONFERENCE
Aug. 1991 471 p The 11th Conference was held in Cleveland, OH, 7-9 May 1991
(NASA-CP-3121; E-6161; NAS 1.55:3121) Avail: NTIS HC/MF A20 CSCL 10B

The Eleventh Space Photovoltaic Research and Technology conference was held at NASA Lewis Research Center from May 7 to 9, 1991. The papers and workshop summaries presented here report remarkable progress on a wide variety of approaches in space photovoltaics, both near and far term applications. Papers were presented in a variety of technical areas, including multijunction cell technology, GaAs and InP cells, system studies, cell and array development, and photovoltaics for conversion of laser radiation. Three workshops were held to discuss thin film cell development, III-V cell development, and space environmental effects. For individual titles, see N91-30204 through N91-30251.

N91-30204*# Spire Corp., Bedford, MA.
TUNNEL JUNCTIONS FOR InP-ON-Si SOLAR CELLS **c44**
C. Keavney, S. Vernon, and V. Haven *In* NASA. Lewis Research Center, Space Photovoltaic Research and Technology Conference Aug. 1991 7 p (For primary document see N91-30203 22-20)
(Contract NAS3-25798)
Avail: NTIS HC/MF A20 CSCL 10B

Growing, by metalorganic chemical vapor deposition, a tunnel junction is described, which makes possible and ohmic back contact in an n-on-p InP solar cell on a silicon substrate. The junction between heavily doped layers of p-type InGaAs and n-type InP shows resistance low enough not to affect the performance of these cells. InP solar cells made on n-type Si substrates with this structure were measured with an efficiency of 9.9 percent. Controls using p-type GaAs substrates showed no significant difference in cell performance, indicating that the resistance associated with the tunnel junction is less than about 0.1 ohm/sq cm. Author

N91-30205*# Midwest Research Inst., Golden, CO. Solar Energy Research Inst.
FABRICATION AND PERFORMANCE ANALYSIS OF 4-SQ CM INDIUM TIN OXIDE/InP PHOTOVOLTAIC SOLAR CELLS **c44**
T. A. Gessert, X. Li, P. W. Phelps, T. J. Coutts, and N. Tzafaras (Bell Telephone Labs., Inc., Reading, PA.) *In* NASA. Lewis Research Center, Space Photovoltaic Research and Technology Conference Aug. 1991 8 p (For primary document see N91-30203 22-20)
(Contract NASA Order C-3000-K; DE-AC02-83CH-10093)
Avail: NTIS HC/MF A20 CSCL 10B

Large-area photovoltaic solar cells based on direct current magnetron sputter deposition of indium tin oxide (ITO) into single-crystal p-InP substrates demonstrated both the radiation hardness and high performance necessary for extraterrestrial applications. A small-scale production project was initiated in which approximately 50 ITO/InP cells are being produced. The procedures used in this small-scale production of 4-sq cm ITO/InP cells are presented and discussed. The discussion includes analyses of performance range of all available production cells, and device performance data of the best cells thus far produced. Additionally, processing experience gained from the production of these cells is discussed, indicating other issues that may be encountered when large-scale productions are begun. Author

N91-30206*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
A COMPARATIVE STUDY OF p(+)n AND n(+)p InP SOLAR CELLS MADE BY A CLOSED AMPOULE DIFFUSION **c44**
M. Faur, M. Faur, D. J. Flood, I. Weinberg, D. J. Brinker, C. Goradia, N. Fatemi (Sverdrup Technology, Inc., Cleveland, OH.), M. Goradia, and W. Thesling *In its* Space Photovoltaic Research and Technology Conference Aug. 1991 12 p (For primary document see N91-30203 22-20)
Avail: NTIS HC/MF A20 CSCL 10B

The purpose was to demonstrate the possibility of fabricating thermally diffused p(+)n InP solar cells having high open-circuit voltage without sacrificing the short circuit current. The p(+)n junctions were formed by closed-ampoule diffusion of Cd through a 3 to 5 nm thick anodic or chemical phosphorus-rich oxide cap layer grown on n-InP:S Czochralski LEC grown substrates. For solar cells made by thermal diffusion the p(+)n configuration is expected to have a higher efficiency than the n(+)p configuration. It is predicted that the AM0, BOL efficiencies approaching 19 percent should be readily achieved providing that good ohmic front contacts could be realized on the p(+) emitters of thickness lower than 1 micron. Author

N91-30207*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
IMPROVEMENTS IN CONTACT RESISTIVITY AND THERMAL STABILITY OF Au-CONTACTED InP SOLAR CELLS **c44**
Navid S. Fatemi (Sverdrup Technology, Inc., Brook Park, OH.) and Victor G. Weizer *In its* Space Photovoltaic Research and Technology Conference Aug. 1991 7 p (For primary document see N91-30203 22-20)
Avail: NTIS HC/MF A20 CSCL 10B

Specific contact resistivities for as-fabricated Au contacts on n-p InP solar cells are typically in the 10(exp -3) ohm/sq cm range, but contact resistivities in the 10(exp -6) ohm/sq cm range can be obtained if the cells are heat treated at 400 C for a few minutes. This heat treatment, however, results in a dramatic drop in the open circuit voltage of the cell due to excessive dissolution of the emitter into the metallization. It was found that low values of contact resistivity can be secured without the accompanying drop in the open circuit voltage by adding Ga and In in the Au metallization. It is shown that Au contacts containing as little as 1 percent atomic Ga can suppress the reaction that takes place at the metal-InP interface during heat treatment, while exhibiting contact resistivity values in the low 10(exp -5) ohm/sq cm. Detailed explanations for the observed superior thermal stability of these contacts are presented. Author

N91-30208*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
GROOVED SURFACES ON InP **c44**
Sheila G. Bailey, Navid S. Fatemi, Geoffrey A. Landis, and Phillip P. Jenkins (Cleveland State Univ., OH.) *In its* Space Photovoltaic Research and Technology Conference Aug. 1991 6 p (For primary document see N91-30203 22-20)
Avail: NTIS HC/MF A20 CSCL 10B

Formation of a textured or grooved front surface on a solar cell can increase the efficiency in several ways, including enhanced absorption and light trapping. In III-IV materials the (111) plane is chemically different form the (1'1'1') plane, and both etching and epitaxial deposition behave differently on these surfaces. The current state of profile etching in InP is summarized. Data are presented on novel geometries attainable as a function of etchant temperature and composition, substrate orientation and carrier concentration, and the oxide thickness between the substrate and the photoresist. Depending on dopant concentration, the same etchant can produce either anisotropic or isotropic grooves. V-grooved solar cells were manufactured on InP, and the improved optical absorption was demonstrated. Preferred parameters for various applications are listed and discussed. Author

N91-30209*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
EFFECT OF DISLOCATIONS ON PROPERTIES OF HETEROEPITAXIAL InP SOLAR CELLS **c44**
I. Weinberg, C. K. Swartz, H. B. Curtis, D. J. Brinker, P. Jenkins, and M. Faur (Cleveland State Univ., OH.) *In its* Space Photovoltaic Research and Technology Conference Aug. 1991 9 p (For primary document see N91-30203 22-20)
Avail: NTIS HC/MF A20 CSCL 10B

The apparently unrelated phenomena of temperature dependency, carrier removal and photoluminescence are shown to be affected by the high dislocation densities present in heteroepitaxial InP solar cells. Using homoepitaxial InP cells as a baseline, it is found that the relatively high dislocation densities present in heteroepitaxial InP/GaAs cells lead to increased volumes of dVoc/dt and carrier removal rate and substantial decreases in photoluminescence spectral intensities. With respect to dVoc/dt, the observed effect is attributed to the tendency of dislocations to reduce Voc. Although the basic cause for the observed increase in carrier removal rate is unclear, it is speculated that the decreased photoluminescence intensity is attributable to defect levels introduced by dislocations in the heteroepitaxial cells. Author

N91-30210*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
HIGH RESOLUTION ELECTROLYTE FOR THINNING InP BY ANODIC DISSOLUTION AND ITS APPLICATIONS TO EC-V PROFILING, DEFECT REVEALING AND SURFACE PASSIVATION **c25**
Maria Faur, Mircea Faur, Irving Weinberg, Manju Goradia, and Carlos Vargas (Kent State Univ., OH.) *In its* Space Photovoltaic Research and Technology Conference Aug. 1991 12 p Prepared in cooperation with Cleveland State Univ., OH (For primary document see N91-30203 22-20)
Avail: NTIS HC/MF A20 CSCL 07D

An extensive experimental study was conducted using various electrolytes in an effort to find an appropriate electrolyte for anodic dissolution of InP. From the analysis of electrochemical characteristics in the dark and under different illumination levels, x ray photoelectron spectroscopy and SEM/Nomarski inspection of the surfaces, it was determined that the anodic dissolution of InP front surface layers by FAP electrolyte is a very good choice for rendering smooth surfaces, free of oxides and contaminants and with good electrical characteristics. The FAP electrolyte, based on HF, CH3COOH, and H2O2 appears to be inherently superior to previously reported electrolytes for performing accurate EC-V profiling of InP at current densities of up to 0.3 mA/sq cm. It can also be used for accurate electrochemical revealing of either precipitates or dislocation density with application to EPD mapping as a function of depth, and for defect revealing of multilayer InP structures at any depth and/or at the interfaces. Author

N91-30211*# Applied Solar Energy Corp., City of Industry, CA.
RECENT ADVANCES IN GaAs/Ge SOLAR CELLS **c44**
C. L. Chu, P. A. Iles, and W. Patterson (Air Force Avionics Lab., Wright-Patterson AFB, OH.) *In* NASA. Lewis Research Center, Space Photovoltaic Research and Technology Conference Aug. 1991 10 p (For primary document see N91-30203 22-20)
Avail: NTIS HC/MF A20 CSCL 10B

By growing the GaAs cell on a Ge substrate, the advantages of GaAs cells can be retained and the higher mechanical strength of the Ge makes larger, thinner GaAs cells possible. To conform to immediate user requirements, GaAs growth conditions were modified to eliminate the additional PV output at GaAs/Ge interface. To demonstrate acceptable cell manufacturing technology, the major areas in cell manufacture were analyzed and developed, and efficiency combined. Also the cells were successfully assembled on current lightweight arrays. The main areas of effort are discussed. Author

N91-30212*# Spectrolab, Inc., Sylmar, CA.
PRODUCTION STATUS OF GaAs/Ge SOLAR CELLS AND PANELS **c44**
B. Smith, M. Gillanders, P. Vijayakumar, D. Lillington, H. Yang, and R. Rolph (Hughes Aircraft Co., Torrance, CA.) *In* NASA. Lewis Research Center, Space Photovoltaic Research and Technology Conference Aug. 1991 7 p (For primary document see N91-30203 22-20)
Avail: NTIS HC/MF A20 CSCL 10B

GaAs/Ge solar cells with lot average efficiencies in excess of 18 percent were produced by MOCVD growth techniques. A description of the cell, its performance and the production facility are discussed. Production GaAs/Ge cells of this type were recently assembled into circuits and bonded to aluminum honeycomb panels to be used as the solar array for the British UOSAT-F program. Author

N91-30213*# State Univ. of New York, Buffalo. Dept. of Electrical and Computer Engineering.
PHOTOREFLECTANCE AND DLTS EVALUATION OF PLASMA-INDUCED DAMAGE IN GaAs AND InP PRIOR TO SOLAR CELL FABRICATION **c44**
L. He and W. A. Anderson *In* NASA. Lewis Research Center, Space Photovoltaic Research and Technology Conference Aug. 1991 9 p (For primary document see N91-30203 22-20)
Avail: NTIS HC/MF A20 CSCL 10B

The effect is considered of plasma etching on both GaAs and InP followed by damage removal using rapid thermal annealing (RTA). Effects of these processes were studied by photoreflectance spectroscopy (PR) and deep level transient spectroscopy (DLTS). These techniques are useful in evaluation of wafers prior to and effects of plasma processing during solar cell fabrication. Author

N91-30214*# Aeronautical Systems Div., Wright-Patterson AFB, OH.

CALCULATION OF GALLIUM-METAL-ARSENIC PHASE DIAGRAMS **c25**

J. D. Scofield, J. E. Davison, A. E. Ray, and S. R. Smith (Dayton Univ., OH.) *In* NASA. Lewis Research Center, Space Photovoltaic Research and Technology Conference Aug. 1991 14 p (For primary document see N91-30203 22-20)
Avail: NTIS HC/MF A20 CSCL 07D

Electrical contacts and metallization to GaAs solar cells must survive at high temperatures for several minutes under specific mission scenarios. The determination of which metallizations or alloy systems that are able to withstand extreme thermal excursions with minimum degradation to solar cell performance can be predicted by properly calculated temperature constitution phase diagrams. A method for calculating a ternary diagram and its three constituent binary phase diagrams is briefly outlined and ternary phase diagrams for three Ga-As-X alloy systems are presented. Free energy functions of the liquid and solid phase are approximated by the regular solution theory. Phase diagrams calculated using this method are presented for the Ga-As-Ge and Ga-As-Ag systems. Author

N91-30215*# Midwest Research Inst., Golden, CO. Solar Energy Research Inst.

GaInP2/GaAs TANDEM CELLS FOR SPACE APPLICATIONS

J. M. Olson, S. R. Kurtz, A. E. Kibbler, K. A. Bertness, and D. J. Friedman *In* NASA. Lewis Research Center, Space Photovoltaic Research and Technology Conference Aug. 1991 9 p (For primary document see N91-30203 22-20)
Avail: NTIS HC/MF A20 CSCL 10B

The monolithic, tunnel-junction-interconnected tandem combination of a GaInP2 top cell and a GaAs bottom cell has achieved a one-sun, AM1.5 efficiency of 27.3 percent. With proper design of the top cell, air mass zero (AM0) efficiencies greater than 25 percent are possible. A description and the advantages of this device for space applications are presented and discussed. The advantages include high-voltage, low-current, two-terminal operation for simple panel fabrication, and high conversion efficiency with low-temperature coefficient. Also, because the active regions of the device are Al-free, the growth of high efficiency devices is not affected by trace levels of O2 or H2O in the MOCVD growth system. Author

N91-30216*# Arizona State Univ., Tempe. Center for Solid State Electronics Research.

TWO-TERMINAL MONOLITHIC InP-BASED TANDEM SOLAR CELLS WITH TUNNELING INTERCELL OHMIC CONNECTIONS **c44**

C. C. Shen, P. T. Chang, and K. A. Emery (Midwest Research Inst., Golden, CO.) *In* NASA. Lewis Research Center, Space Photovoltaic Research and Technology Conference Aug. 1991 8 p (For primary document see N91-30203 22-20)
Avail: NTIS HC/MF A20 CSCL 10B

A monolithic two-terminal InP/InGaAsP tandem solar cell was successfully fabricated. This tandem solar cell consists of a p/n InP homojunction top subcell and a 0.95 eV p/n InGaAsP homojunction bottom subcell. A patterned 0.95 eV n(+)/p(+) InGaAsP tunnel diode was employed as an intercell ohmic connection. The solar cell structure was prepared by two-step liquid phase epitaxial growth. Under one sun, AM1.5 global illumination, the best tandem cell delivered a conversion efficiency of 14.8 pct. Author

N91-30217*# Boeing Aerospace Co., Seattle, WA. Aerospace and Electronics.

GaAs (AlGaAs)/CuInSe2 TANDEM SOLAR CELLS. TECHNOLOGY STATUS AND FUTURE DIRECTIONS

N. P. Kim, R. M. Burgess, R. P. Gale, and R. W. McClelland (Kopin Corp., Taunton, MA.) *In* NASA. Lewis Research Center, Space Photovoltiac Research and Technology Conference Aug. 1991 10 p (For primary document see N91-30203 22-20)
Avail: NTIS HC/MF A20 CSCL 10B

Mechanically stacked, high efficiency, lightweight, and radiation resistant photovoltaic cells based on a GaAs thin film top and CuInSe2 thin film bottom cells were developed, and are considered one of the most promising devices for planar solar array applications. The highest efficiency demonstrated so far using the 4 sq cm design is 23.1 pct. AM0, one sun efficiency when measured in four-terminal configuration. The current status of the GaAs(AlGaAs)/CuInSe2 tandem cell program is presented and future directions that will lead to cell efficiencies higher than 26 pct. Air Mass Zero (AM0). A new 8 sq cm cell design developed for a two terminal and voltage matched configuration to minimize wiring complexity is discussed. Optimization of the GaAs structure for a higher end-of-life performance and further improvement of tandem cells by utilizing AlGaAs as an top absorber are described. Results of environmental tests conducted with these thin film GaAs/CuInSe2 tandem cells are also summarized. Author

N91-30218*# Astropower, Inc., Newark, DE.

DEVELOPMENT OF N/P AlGaAs FREE-STANDING TOP SOLAR CELLS FOR TANDEM APPLICATIONS **c44**

Gerald H. Negley, Louis C. DiNetta, John R. Cummings, Margaret H. Hannon, Paul E. Sims, and Allen M. Barnett (Delaware Univ., Newark.) *In* NASA. Lewis Research Center, Space Photovoltaic Research and Technology Conference Aug. 1991 5 p (For primary document see N91-30203 22-20)
(Contract F33615-91-C-2144)
Avail: NTIS HC/MF A20 CSCL 10B

The combination of a free standing AlGaAs top solar cell and an existing bottom solar cell is the highest performance, lowest risk approach to implementing the tandem cell concept. The solar cell consists of an AlGaAs substrate layer, an AlGaAs base layer, an AlGaAs emitter, and an ultra-thin AlGaAs window layer. The window layer is compositionally graded which minimizes reflection at the window layer/emitter interface and creates a built-in electric field to improve quantum response in the blue region of the spectrum. Liquid phase epitaxy (LPE) is the only viable method to produce this free standing top solar cell. Small (0.125 sq cm), transparent p/n AlGaAs top solar cells were demonstrated with optimum bandgap for combination with a silicon bottom solar cell. The efficiency of an AlGaAs/Si stack using the free standing AlGaAs device upon an existing silicon bottom solar cell is 24 pct. (1X, Air Mass Zero (AM0). The n/p AlGaAs top solar cell is being developed in order to facilitate the wiring configuration. The two terminal tandem stack will retain fit, form, and function of existing silicon solar cells. Progress in the development of large area (8 and 16 sq cm), free standing AlGaAs top solar cells is discussed. Author

N91-30219*# Midwest Research Inst., Golden, CO. Solar Energy Research Inst.

MONOLITHIC InP/Ga0.47In0.53As TANDEM SOLAR CELLS FOR SPACE

M. W. Wanlass, J. S. Ward, T. J. Coutts, K. A. Emery, T. A. Gessert, and C. R. Osterwald *In* NASA. Lewis Research Center, Space Photovoltaic Research and Technology Conference Aug. 1991 10 p Sponsored in part by Navy (For primary document see N91-30203 22-20)
Avail: NTIS HC/MF A20 CSCL 10B

A review is provided of progress made in the development of InP/Ga(0.47)In(0.53)As monolithic tandem solar cells since the last SPRAT conference. Improved one-sun, three terminal tandem designs have resulted in Air Mass Zero (AM0) efficiencies as high as 23.9 pct. at 25 C. Additionally, high efficiency concentrator versions of the three terminal device were developed. The best

concentrator tandem has a peak AM0 efficiency of 28.8 pct. under 40.3 suns at 25 C. For the concentrator tandems, the subcell performance parameter temperature coefficients are reported as a function of the concentration ratio. Results from a computer modeling study are presented which provide a clear direction for improving the efficiency of the concentrator tandem. The prospects for fabricating high efficiency, series connected (i.e., two terminal) InP/Ga(0.47)In(0.53)As monolithic tandem cells are also discussed. Author

N91-30220*# Varian Associates, Palo Alto, CA.
RECENT ADVANCEMENTS IN MONOLITHIC AlGaAs/GaAs SOLAR CELLS FOR SPACE APPLICATIONS
K. R. Wickham, B.-C. Chung, M. Klausmeier-Brown, M. S. Kuryla, M. Ladle Ristow, G. F. Virshup, and J. G. Werthen *In* NASA. Lewis Research Center, Space Photovoltaic Research and Technology Conference Aug. 1991 7 p (For primary document see N91-30203 22-20)
Avail: NTIS HC/MF A20 CSCL 10B

High efficiency, two terminal, multijunction AlGaAs/GaAs solar cells were reproducibly made with areas of 0.5 sq cm. The multiple layers in the cells were grown by Organo Metallic Vapor Phase Epitaxy (OMVPE) on GaAs substrates in the n-p configuration. The upper AlGaAs cell has a bandgap of 1.93 eV and is connected in series to the lower GaAs cell (1.4 eV) via a metal interconnect deposited during post-growth processing. A prismatic coverglass is installed on top of the cell to reduce obscuration caused by the gridlines. The best 0.5 sq cm cell has a two terminal efficiency of 23.0 pct. at 1 sun, air mass zero (AM0) and 25 C. To date, over 300 of these cells were grown and processed for a manufacturing demonstration. Yield and efficiency data for this demonstration are presented. As a first step toward the goal of a 30 pct. efficient cell, a mechanical stack of the 0.5 sq cm cells described above, and InGaAsP (0.95 eV) solar cells was made. The best two terminal measurement to date yields an efficiency of 25.2 pct. AM0. This is the highest reported efficiency of any two terminal, 1 sun space solar cell. Author

N91-30221*# Astropower, Inc., Newark, DE.
DIRECT GLASS BONDED HIGH SPECIFIC POWER SILICON SOLAR CELLS FOR SPACE APPLICATIONS
L. C. DiNetta, J. A. Rand, J. R. Cummings, S. M. Lampo, K. P. Shreve, and Allen M. Barnett (Delaware Univ., Newark.) *In* NASA. Lewis Research Center, Space Photovoltaic Research and Technology Conference Aug. 1991 7 p (For primary document see N91-30203 22-20)
(Contract F33615-90-C-2060)
Avail: NTIS HC/MF A20 CSCL 10B

A lightweight, radiation hard, high performance, ultra-thin silicon solar cell is described that incorporates light trapping and a cover glass as an integral part of the device. The manufacturing feasibility of high specific power, radiation insensitive, thin silicon solar cells was demonstrated experimentally and with a model. Ultra-thin, light trapping structures were fabricated and the light trapping demonstrated experimentally. The design uses a micro-machined, grooved back surface to increase the optical path length by a factor of 20. This silicon solar cell will be highly tolerant to radiation because the base width is less than 25 microns making it insensitive to reduction in minority carrier lifetime. Since the silicon is bonded without silicone adhesives, this solar cell will also be insensitive to UV degradation. These solar cells are designed as a form, fit, and function replacement for existing state of the art silicon solar cells with the effect of simultaneously increasing specific power, power/area, and power supply life. Using a 3-mil thick cover glass and a 0.3 g/sq cm supporting Al honeycomb, a specific power for the solar cell plus cover glass and honeycomb of 80.2 W/Kg is projected. The development of this technology can result in a revolutionary improvement in high survivability silicon solar cell products for space with the potential to displace all existing solar cell technologies for single junction space applications. Author

N91-30222*# Martin Marietta Corp., Denver, CO. Defense Space and Communications.
FLEXIBLE COPPER-INDIUM-DISELENIDE FILMS AND DEVICES FOR SPACE APPLICATIONS
J. H. Armstrong, C. O. Pistole, M. S. Misra, V. K. Kapur, and B. M. Basol (International Solar Electric Technology, Inglewood, CA.) *In* NASA. Lewis Research Center, Space Photovoltaic Research and Technology Conference Aug. 1991 8 p (For primary document see N91-30203 22-20)
Avail: NTIS HC/MF A20 CSCL 10B

With the ever increasing demands on space power systems, it is imperative that low cost, lightweight, reliable photovoltaics be developed. One avenue of pursuit for future space power applications is the use of low cost, lightweight flexible PV cells and arrays. Most work in this area assumes the use of flexible amorphous silicon (a-Si), despite its inherent instability and low efficiencies. However, polycrystalline thin film PV such as copper-indium-diselenide (CIS) are inherently more stable and exhibit better performance than a-Si. Furthermore, preliminary data indicate that CIS also offers exciting properties with respect to space applications. However, CIS has only heretofore only produced on rigid substrates. The implications of flexible CIS upon present and future space power platforms was explored. Results indicate that space qualified CIS can dramatically reduce the cost of PV, and in most cases, can be substituted for silicon (Si) based on end-of-life (EOL) estimations. Furthermore, where cost is a prime consideration, CIS can become cost effective than gallium arsenide (GaAs) in some applications. Second, investigations into thin film deposition on flexible substrates were made, and data from these tests indicate that fabrication of flexible CIS devices is feasible. Finally, data is also presented on preliminary TCO/CdS/CuInSe2/Mo devices. Author

N91-30223*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
KEY RESULTS OF THE MINI-DOME FRESNEL LENS CONCENTRATOR ARRAY DEVELOPMENT PROGRAM UNDER RECENTLY COMPLETED NASA AND SDIO SBIR PROJECTS
Mark J. ONeill, Michael F. Piszczor, and Lewis M. Fraas (Boeing Co., Seattle, WA.) *In its* Space Photovoltaic Research and Technology Conference Aug. 1991 12 p (For primary document see N91-30203 22-20)
Avail: NTIS HC/MF A20 CSCL 10B

Since 1986, ENTECH and the NASA Lewis Research Center have been developing a new photovoltaic concentrator system for space power applications. The unique refractive system uses small, dome shaped Fresnel lenses to focus sunlight onto high efficiency photovoltaic concentrator cells which use prismatic cell covers to further increase their performance. Highlights of the five-year development include near Air Mass Zero (AM0) Lear Jet flight testing of mini-dome lenses (90 pct. net optical efficiency achieved); tests verifying sun-pointing error tolerance with negligible power loss; simulator testing of prism-covered GaAs concentrator cells (24 pct. AM0 efficiency); testing of prism-covered Boeing GaAs/GaSb tandem cells (31 pct. AM0 efficiency); and fabrication and outdoor testing of a 36-lens/cell element panel. These test results have confirmed previous analytical predictions which indicate substantial performance improvements for this technology over current array systems. Based on program results to date, it appears than an array power density of 300 watts/sq m and a specific power of 100 watts/kg can be achieved in the near term. All components of the array appear to be readily manufacturable from space-durable materials at reasonable cost. A concise review is presented of the key results leading to the current array, and further development plans for the future are briefly discussed.
Author

N91-30224*# Energy Conversion Devices, Inc., Troy, MI.
THE STATUS OF LIGHTWEIGHT PHOTOVOLTAIC SPACE ARRAY TECHNOLOGY BASED ON AMORPHOUS SILICON SOLAR CELLS
Joseph J. Hanak and Jim Kaschmitter (Lawrence Livermore National Lab., CA.) *In* NASA. Lewis Research Center, Space

Photovoltaic Research and Technology Conference Aug. 1991 10 p (For primary document see N91-30203 22-20)
(Contract B103159)
Avail: NTIS HC/MF A20 CSCL 10B

Ultralight, flexible photovoltaic (PV) array of amorphous silicon (a-Si) was identified as a potential low cost power source for small satellites. A survey was conducted of the status of the a-Si PV array technology with respect to present and future performance, availability, cost, and risks. For existing, experimental array blankets made of commercial cell material, utilizing metal foil substrates, the Beginning of Life (BOL) performance at Air Mass Zero (AM0) and 35 C includes total power up to 200 W, power per area of 64 W/sq m and power per weight of 258 W/kg. Doubling of power per weight occurs when polyimide substrates are used. Estimated End of Life (EOL) power output after 10 years in a nominal low earth orbit would be 80 pct. of BOL, the degradation being due to largely light induced effects (-10 to -15 pct.) and in part (-5 pct.) to space radiation. Predictions for the year 1995 for flexible PV arrays, made on the basis of published results for rigid a-Si modules, indicate EOL power output per area and per weight of 105 W/sq m and 400 W/kg, respectively, while predictions for the late 1990s based on existing U.S. national PV program goals indicate EOL values of 157 W/sq m and 600 W/kg. Cost estimates by vendors for 200 W ultralight arrays in volume of over 1000 units range from $100/watt to $125/watt. Identified risks include the lack of flexible, space compatible encapsulant, the lack of space qualification effort, recent partial or full acquisitions of US manufacturers of a-Si cells by foreign firms, and the absence of a national commitment for a long range development program toward developing of this important power source for space. Author

N91-30225*# Applied Solar Energy Corp., City of Industry, CA.
REVERSE BIAS VOLTAGE TESTING OF 8 cm x 8cm SILICON SOLAR CELLS
T. Woike, S. Stotlar, and C. Lungu *In* NASA. Lewis Research Center, Space Photovoltaic Research and Technology Conference Aug. 1991 10 p (For primary document see N91-30203 22-20)
Avail: NTIS HC/MF A20 CSCL 10B

A study is described of the reverse I-V characteristics of the largest space qualified silicon solar cells currently available (8 x 8 cm) and of reverse bias voltage (RBV) testing performed on these cells. This study includes production grade cells, both with and without cover glass. These cells span the typical output range seen in production. Initial characteristics of these cells are measured at both 28 and 60 C. These measurements show weak correlation between cell output and reverse characteristics. Analysis is presented to determine the proper conditions for RBV stress to simulate shadowing effects on a particular array design. After performing the RBV stress the characteristics of the stressed cells are remeasured. The degradation in cell performance is highly variable which exacerbates cell mismatching over time. The effect of this degradation on array lifetime is also discussed. Generalization of these results to other array configurations is also presented. Author

N91-30226*# Schafer (W. J.) Associates, Inc., Arlington, VA.
MASS PROPERTIES SURVEY OF SOLAR ARRAY TECHNOLOGIES
Robert Kraus *In* NASA. Lewis Research Center, Space Photovoltaic Research and Technology Conference Aug. 1991 6 p (For primary document see N91-30203 22-20)
Avail: NTIS HC/MF A20 CSCL 10B

An overview of the technologies, electrical performance, and mass characteristics of many of the presently available and the more advanced developmental space solar array technologies is presented. Qualitative trends and quantitative mass estimates as total array output power is increased from 1 kW to 5 kW at End of Life (EOL) from a single wing are shown. The array technologies are part of a database supporting an ongoing solar power subsystem model development for top level subsystem and technology analyses. The model is used to estimate the overall electrical and thermal performance of the complete subsystem, and then calculate the mass and volume of the array, batteries, power management, and thermal control elements as an initial sizing. The array types considered here include planar rigid panel designs, flexible and rigid fold-out planar arrays, and two concentrator designs, one with one critical axis and the other with two critical axes. Solar cell technologies of Si, GaAs, and InP were included in the analyses. Comparisons were made at the array level; hinges, booms, harnesses, support structures, power transfer, and launch retention mountings were included. It is important to note that the results presented are approximations, and in some cases revised or modified performance and mass estimates of specific designs. Author

N91-30227*# Sverdrup Technology, Inc., Cleveland, OH.
SPACE POWER BY LASER ILLUMINATION OF PV ARRAYS
Geoffrey A. Landis *In* NASA. Lewis Research Center, Space Photovoltaic Research and Technology Conference Aug. 1991 5 p (For primary document see N91-30203 22-20)
Avail: NTIS HC/MF A20 CSCL 10B

There has recently been a resurgence of interest in the use of beamed power to support space exploration activities. The utility is examined of photovoltaics and problem and research areas are identified for photovoltaics in two beamed-power applications: to convert incident laser radiation to power at a remote receiving station, and as a primary power source on space based power station transmitting power to a remote user. A particular application of recent interest is to use a ground-based free electron laser as a power source for space applications. Specific applications include: night power for a moonbase by laser illumination of the moonbase solar arrays; use of a laser to provide power for satellites in medium and geosynchronous Earth orbit, and a laser powered system for an electrical propulsion orbital transfer vehicle. These and other applications are currently being investigated at NASA Lewis as part of a new program to demonstrate the feasibility of laser transmission of power for space. Author

N91-30228*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
POTENTIAL CONVERTER FOR LASER-POWER BEAMING
Gilbert H. Walker, Michael D. Williams, Gregory L. Schuster, and Peter A. Iles (Applied Solar Energy Corp., City of Industry, CA.) *In* NASA. Lewis Research Center, Space Photovoltaic Research and Technology Conference Aug. 1991 5 p (For primary document see N91-30203 22-20)
Avail: NTIS HC/MF A20 CSCL 10B

Future space missions, such as those associated with the Space Exploration Initiative (SEI), will require large amounts of power for operation of bases, rovers, and orbit transfer vehicles. One method for supplying this power is to beam power from a spaced based or Earth based laser power station to a receiver where laser photons can be converted to electricity. Previous research has described such laser power stations orbiting the Moon and beaming power to a receiver on the surface of the Moon by using arrays of diode lasers. Photovoltaic converters that can be efficiently used with these diode lasers are described. Author

N91-30229*# Washington State Univ., Richland.
GaAs SOLAR CELLS FOR LASER POWER BEAMING
Larry C. Olsen, Glen Dunham, Daniel A. Huber, F. William Addis, Norman Anheier, and E. P. Coomes (Battelle Pacific Northwest Labs., Richland, WA.) *In* NASA. Lewis Research Center, Space Photovoltaic Research and Technology Conference Aug. 1991 9 p (For primary document see N91-30203 22-20)
Avail: NTIS HC/MF A20 CSCL 10B

Efforts to develop GaAs solar cells for coupling to laser beams in the wavelength range of 800 to 840 nm are described. This work was motivated primarily by interests in space-tp-space power beaming applications. In particular, the Battelle Pacific Northwest Laboratories is conducting studies of the utilization of power beaming for several future space missions. Modeling calculations of GaAs cell performance were carried out using PC-1D to determine an appropriate design for a p/n cell structure. Epitaxial

wafers were grown by MOCVD and cells fabricated at WSU Tri-Cities. Under simulated conditions, an efficiency of 53 percent was achieved for a cell coupled to 806 nm light at 400 mW/sq cm. Author

N91-30230*# Midwest Research Inst., Golden, CO. Solar Energy Research Inst.

HIGH-EFFICIENCY HETEROEPITAXIAL InP SOLAR CELLS

M. W. Wanlass, T. J. Coutts, J. S. Ward, and K. A. Emery *In* NASA. Lewis Research Center, Space Photovoltaic Research and Technology Conference Aug. 1991 9 p (For primary document see N91-30203 22-20)

Avail: NTIS HC/MF A20 CSCL 10B

High-efficiency, thin-film InP solar cells grown heteroepitaxially on GaAs and Si single-crystal bulk substrates are being developed as a means of eliminating the problems associated with using single-crystal InP substrates. A novel device structure employing a compositionally graded Ga(x)In(1-x)As layer between the bulk substrate and the InP cell layers is used to reduce the dislocation density and improve the minority carrier properties in the InP. The structures are grown in a continuous sequence of steps using computer-controlled atmospheric pressure metalorganic vapor phase epitaxy (APMOVPE). Dislocation densities as low as 3 x 10(exp 7) sq cm and minority carrier lifetimes as high as 3.3 ns are achieved in the InP layers with this method using both GaAs or Si substrates. Structures prepared in this fashion are also completely free of microcracks. These results represent a substantial improvement in InP layer quality when compared to heteroepitaxial InP prepared using conventional techniques such as thermally cycled growth and post-growth annealing. The present work is concerned with the fabrication and characterization of high-efficiency, thin-film InP solar cells. Both one-sun and concentrator cells were prepared for device structures grown on GaAs substrates. One-cell cells have efficiencies as high as 13.7 percent at 25 C. However, results for the concentrator cells are emphasized. The concentrator cell performance is characterized as a function of the air mass zero (AM0) solar concentration ratio and operating temperature. From these data, the temperature coefficients of the cell performance parameters are derived as a function of the concentration ratio. Under concentration, the cells exhibit a dramatic increase in efficiency and an improved temperature coefficient of efficiency. At 25 C, a peak conversion efficiency of 18.9 percent is reported. At 80 C, the peak AM0 efficiency is 15.7 percent at 75.6 suns. These are the highest efficiencies yet reported for InP heteroepitaxial cells. Approaches for further improving the cell performance are discussed. Author

N91-30231*# Midwest Research Inst., Golden, CO. Solar Energy Research Inst.

InP CONCENTRATOR SOLAR CELLS FOR SPACE APPLICATIONS

J. S. Ward, M. W. Wanlass, T. J. Coutts, and K. A. Emery *In* NASA. Lewis Research Center, Space Photovoltaic Research and Technology Conference Aug. 1991 5 p (For primary document see N91-30203 22-20)

Avail: NTIS HC/MF A20 CSCL 10B

The design, fabrication, and characterization of high-performance, n(+)/p InP shallow-homojunction (SHJ) concentrator solar cell is described. The InP device structures were grown by atmospheric-pressure metalorganic vapor phase epitaxy (APMOVPE). A preliminary assessment of the effects of grid collection distance and emitter sheet resistance on cell performance is presented. At concentration ratios of over 100, cells with AM0 efficiencies in excess of 21 percent at 25 C and 19 percent at 80 C are reported. These results indicate that high-efficiency InP concentrator cells can be fabricated using existing technologies. The performance of these cells as a function of temperature is discussed, and areas for future improvement are outlined. Author

N91-30232*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

COMPARATIVE MODELING OF InP SOLAR CELL STRUCTURES

R. K. Jain, I. Weinberg, and D. J. Flood *In its* Space Photovoltaic Research and Technology Conference Aug. 1991 9 p Prepared in cooperation with National Academy of Sciences/National Research Council, Washington (For primary document see N91-30203 22-20)

Avail: NTIS HC/MF A20 CSCL 10B

The comparative modeling of p(+)n and n(+)p indium phosphide solar cell structures is studied using a numerical program PC-1D. The optimal design study has predicted that the p(+)n structure offers improved cell efficiencies as compared to n(+)p structure, due to higher open-circuit voltage. The various cell material and process parameters to achieve the maximum cell efficiencies are reported. The effect of some of the cell parameters on InP cell I-V characteristics was studied. The available radiation resistance data on n(+)p and p(+)p InP solar cells are also critically discussed. Author

N91-30233*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

A THEORETICAL COMPARISON OF THE NEAR-OPTIMUM DESIGN AND PREDICTED PERFORMANCE OF n/p AND p/n INDIUM PHOSPHIDE HOMOJUNCTION SOLAR CELLS

Chandra Goradia, William Thesling, and Irving Weinberg *In its* Space Photovoltaic Research and Technology Conference Aug. 1991 10 p Prepared in cooperation with Cleveland State Univ., OH (For primary document see N91-30203 22-20)

Avail: NTIS HC/MF A20 CSCL 10B

Using a detailed simulation model of p(+)nn(+) and n(+)pp(+) indium phosphide (InP) homojunction solar cells, extensive parametric variation computer simulation runs were performed to aid in making near-optimum designs for these two solar cell configurations. The values of all the geometrical and material parameters corresponding to the near-optimal designs of both these configurations are presented. The results of parametric variation runs are presented for each configuration showing how the performance parameters J(sub sc), V(sub oc), and eta vary with each of the cell design parameters for the near-optimally designed cell. Finally, the theoretically obtained results are discussed, and the relative merits and drawbacks of the two configurations are compared. Author

N91-30234*# Cleveland State Univ., OH. Dept. of Electrical Engineering.

FIESTA ROC: A NEW FINITE ELEMENT ANALYSIS PROGRAM FOR SOLAR CELL SIMULATION **c44**

Ralph O. Clark *In* NASA. Lewis Research Center, Space Photovoltaic Research and Technology Conference Aug. 1991 6 p (For primary document see N91-30203 22-20)

Avail: NTIS HC/MF A20 CSCL 10B

The Finite Element Semiconductor Three-dimensional Analyzer by Ralph O. Clark (FIESTA ROC) is a computational tool for investigating in detail the performance of arbitrary solar cell structures. As its name indicates, it uses the finite element technique to solve the fundamental semiconductor equations in the cell. It may be used for predicting the performance (thereby dictating the design parameters) of a proposed cell or for investigating the limiting factors in an established design. Author

N91-30235*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

SIGNIFICANT REDUCTION IN ARC FREQUENCY BIASED SOLAR CELLS: OBSERVATIONS, DIAGNOSTICS, AND MITIGATION TECHNIQUE(S)

B. L. Upschulte, G. M. Weyl, W. J. Marinelli, E. Aifer, D. Hastings (Massachusetts Inst. of Tech., Cambridge.), and D. Snyder *In its* Space Photovoltaic Research and Technology Conference Aug. 1991 10 p (For primary document see N91-30203 22-20)

Avail: NTIS HC/MF A20 CSCL 10B

A variety of experiments were performed which identify key

factors contributing to the arcing of negatively biased high voltage solar cells. These efforts have led to reduction of greater than a factor of 100 in the arc frequency of a single cell following proper remediation procedures. Experiments naturally lead to and focussed on the adhesive/encapsulant that is used to bond the protective cover slip to the solar cell. An image-intensified charge coupled device (CCD) camera system recorded UV emission from arc events which occurred exclusively along the interfacial edge between the cover slip and the solar cell. Microscopic inspection of this interfacial region showed a bead of encapsulant along this entire edge. Elimination of this encapsulant bead reduced the arc frequency by two orders of magnitude. Water contamination was also identified as a key contributor which enhances arcing of the encapsulant bead along the solar cell edge. Spectrally resolved measurements of the observable UV light shows a feature assignable to OH(A-X) electronic emission, which is common for water contaminated discharges. Experiments in which the solar cell temperature was raised to 85 C showed a reduced arcing frequency, suggesting desorption of H2O. Exposing the solar cell to water vapor was shown to increase the arcing frequency. Clean dry gases such as O2, N2, and Ar show no enhancement of the arcing rate. Elimination of the exposed encapsulant eliminates any measurable sensitivity to H2O vapor. Author

N91-30236*# Air Force Geophysics Lab., Hanscom AFB, MA.
MEASUREMENT OF HIGH-VOLTAGE AND RADIATION-DAMAGE LIMITATIONS TO ADVANCED SOLAR ARRAY PERFORMANCE
D. A. Guidice, P. S. Severance, and K. C. Keinhardt (Aeronautical Systems Div., Wright-Patterson AFB, OH.) *In* NASA. Lewis Research Center, Space Photovoltaic Research and Technology Conference Aug. 1991 10 p (For primary document see N91-30203 22-20)
Avail: NTIS HC/MF A20 CSCL 10B

A description is given of the reconfigured Photovoltaic Array Space Power (PASP) Plus experiment: its objectives, solar-array complement, and diagnostic sensors. Results from a successful spaceflight will lead to a better understanding of high-voltage and radiation-damage limitations in the operation of new-technology solar arrays. Author

N91-30237*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
LEO MICROMETEORITE/DEBRIS IMPACT DAMAGE c18
Paul M. Stella *In* NASA. Lewis Research Center, Space Photovoltaic Research and Technology Conference Aug. 1991 7 p (For primary document see N91-30203 22-20)
Avail: NTIS HC/MF A20 CSCL 22B

The school bus sized Long Duration Exposure Facility (LDEF) was retrieved in 1990, after nearly six years of 250 nautical mile altitude low earth orbit environmental exposure. The recovery of LDEF experiments has provided extensive information on space interactions, including micrometeorite, debris, atomic oxygen, ultraviolet, and particulate radiation. The Jet Propulsion Laboratory provided a test plate as part of Solar-Array-Materials Passive LDEF (SAMPLE) Experiment. The test plate contained thirty thin silicon solar cell/cover assemblies. The cover samples included a variety of materials such as Teflon and RTV silicones, in addition to conventional microsheet. The nature of the approximately 150 micrometeorite/debris impacts on the cell/cover samples, cell interconnects, and aluminum test plate is discussed. Author

N91-30238*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
THE EFFECTS OF LUNAR DUST ACCUMULATION ON THE PERFORMANCE OF PHOTOVOLTAIC ARRAYS
Cynthia M. Katzan, David J. Brinker, and Robert Kress (Akron Univ., OH.) *In its* Space Photovoltaic Research and Technology Conference Aug. 1991 8 p (For primary document see N91-30203 22-20)
(Contract NAS3-25266)
Avail: NTIS HC/MF A20 CSCL 10B

Lunar base activity, particularly rocket launch and landing, will suspend and transport lunar dust. From preliminary models, the resulting dust accumulation can be significant, even as far as 2 km from the source. For example, at 2 km approximately 0.28 mg/sq cm of dust is anticipated to accumulate after only 10 surface missions with a 26,800 N excursion vehicle. The possible associated penalties in photovoltaic array performance were therefore the subject of experimental as well as theoretical investigation. To evaluate effects of dust accumulation on relative power output, current-voltage characteristics of dust-covered silicon cells were determined under the illumination of a Spectrolab X-25L solar simulator. The dust material used in these experiments was a terrestrial basalt which approximated lunar soil in particle size and composition. Cell short circuit current, an indicator of the penetrating light intensity, was found to decrease exponentially with dust accumulation. This was predicted independently by modeling the light occlusion caused by a growing layer of dust particles. Moreover, the maximum power output of dust-covered cells, derived from the I-V curves, was also found to degrade exponentially. Experimental results are presented and potential implications discussed. Author

N91-30239*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
RAPID THERMAL CYCLING OF SOLAR ARRAY BLANKET COUPONS FOR SPACE STATION FREEDOM
David A. Scheiman (Sverdrup Technology, Inc., Brook Park, OH.) and Bryan K. Smith *In its* Space Photovoltaic Research and Technology Conference Aug. 1991 9 p (For primary document see N91-30203 22-20)
(Contract NAS3-25266)
Avail: NTIS HC/MF A20 CSCL 10B

The NASA Lewis Research Center has been conducting rapid thermal cycling on blanket coupons for Space Station Freedom. This testing includes two designs (8 coupons total) of the solar array. Four coupons were fabricated as part of the Photovoltaic Array Environmental Protection Program (PAEP), NAS3-25079, at Lockheed Missiles and Space Company. These coupons began cycling in early 1989 and have completed 172,000 thermal cycles. Four other coupons were fabricated a year later and included several design changes; cycling of these began in early 1990 and has reached 90,000 cycles. The objective of this testing is to demonstrate the durability or operational lifetime (15 yrs.) of the welded interconnects within a low earth orbit (LEO) thermal cycling environment. The blanket coupons, design changes, test description, status to date including performance and observed anomalies, and any insights related to the testing of these coupons are described. The description of a third design is included.
Author

N91-30240*# Research Triangle Inst., Research Triangle Park, NC.
RADIATION RESISTANCE OF Ge, Ge0.93Si0.07, GaAs AND Al0.08Ga0.92 AS SOLAR CELLS
M. L. Timmons, R. Venkatasubramanian, P. A. Iles, and C. L. Chu (Applied Solar Energy Corp., City of Industry, CA.) *In* NASA. Lewis Research Center, Space Photovoltaic Research and Technology Conference Aug. 1991 10 p (For primary document see N91-30203 22-20)
(Contracts F33615-87-C-2804; F33615-88-C-2847)
Avail: NTIS HC/MF A20 CSCL 10B

Solar cells made of Ge, Ge(0.93)Si(0.07) alloys, GaAs and Al(0.08)Ga(0.92)As were irradiated in two experiments with 1-meV electrons at fluences as great as 1 x 10(exp 16) cm(exp-2). Several general trends have emerged. Low-band-gap Ge and Ge(0.93) Si(0.07) cells show substantial resistance to radiation-induced damage. The two experiments showed that degradation is less for Al(0.08)Ga(0.92)As cells than for similarly irradiated GaAs cells. Compared to homojunctions, cells with graded-band-gap emitters did not show the additional resistance to damage in the second experiment that had been seen in the first. The thickness of the emitter is a key parameter to limit the degradation in GaAs devices. Author

N91-30241*# Johns Hopkins Univ., Laurel, MD. Applied Physics Lab.

GALLIUM ARSENIDE SOLAR CELL RADIATION DAMAGE EXPERIMENT

R. H. Maurer, J. D. Kinnison, G. A. Herbert, and A. Meulenberg (Communications Satellite Corp., Clarksburg, MD.) *In* NASA. Lewis Research Center, Space Photovoltaic Research and Technology Conference Aug. 1991 11 p (For primary document see N91-30203 22-20)

Avail: NTIS HC/MF A20 CSCL 10B

Gallium arsenide (GaAs) solar cells for space applications from three different manufactures were irradiated with 10 MeV protons or 1 MeV electrons. The electrical performance of the cells was measured at several fluence levels and compared. Silicon cells were included for reference and comparison. All the GaAs cell types performed similarly throughout the testing and showed a 36 to 56 percent power areal density advantage over the silicon cells. Thinner (8-mil versus 12-mil) GaAs cells provide a significant weight reduction. The use of germanium (Ge) substrates to improve mechanical integrity can be implemented with little impact on end of life performance in a radiation environment. Author

N91-30242*# Communications Satellite Corp., Clarksburg, MD.

A I-V ANALYSIS OF IRRADIATED GALLIUM ARSENIDE SOLAR CELLS **c33**

A. Heulenberg, R. H. Maurer, and J. D. Kinnison (Johns Hopkins Univ., Laurel, MD.) *In* NASA. Lewis Research Center, Space Photovoltaic Research and Technology Conference Aug. 1991 6 p Sponsored in part by NASA, and by Communications Satellite Corp. (For primary document see N91-30203 22-20)

Avail: NTIS HC/MF A20 CSCL 09C

A computer program was used to analyze the illuminated I-V characteristics of four sets of gallium arsenide (GaAs) solar cells irradiated with 1-MeV electrons and 10-MeV protons. It was concluded that junction regions (J sub r) dominate nearly all GaAs cells tested, except for irradiated Mitsubishi cells, which appear to have a different doping profile. Irradiation maintains or increases the dominance by J sub r. Proton irradiation increases J sub r more than does electron irradiation. The U.S. cells were optimized for beginning of life (BOL) and the Japanese for end of life (EOL). I-V analysis indicates ways of improving both the BOL and EOL performance of GaAs solar cells. Author

N91-30243*# Midwest Research Inst., Golden, CO. Solar Energy Research Inst.

RADIATION HARDNESS OF Ga0.5In0.5 P/GaAs TANDEM SOLAR CELLS **c44**

Sarah R. Kurtz, J. M. Olson, K. A. Bertness, D. J. Friedman, A. Kibbler, B. T. Cavicchi, and D. D. Krut (Spectrolab, Inc., Sylmar, CA.) *In* NASA. Lewis Research Center, Space Photovoltaic Research and Technology Conference Aug. 1991 7 p (For primary document see N91-30203 22-20)

Avail: NTIS HC/MF A20 CSCL 10B

The radiation hardness of a two-junction monolithic Ga sub 0.5 In sub 0.5 P/GaAs cell with tunnel junction interconnect was investigated. Related single junction cells were also studied to identify the origins of the radiation losses. The optimal design of the cell is discussed. The air mass efficiency of an optimized tandem cell after irradiation with 10(exp 15) cm (-2) 1 MeV electrons is estimated to be 20 percent using currently available technology. Author

N91-30244*# Boeing Co., Seattle, WA. High Technology Center.

THE EFFECTS OF ELECTRON AND PROTON RADIATION ON GaSb INFRARED SOLAR CELLS **c44**

P. E. Gruenbaum, J. E. Avery, and L. M. Fraas *In* NASA. Lewis Research Center, Space Photovoltaic Research and Technology Conference Aug. 1991 8 p (For primary document see N91-30203 22-20)

Avail: NTIS HC/MF A20 CSCL 10B

Gallium antimonide (GaSb) infrared solar cells were exposed to 1 MeV electrons and protons up to fluences of 1 times 10(exp 15) cm (-2) and 1 times 10(exp 12) cm (-2) respectively. In between exposures, current voltage and spectral response curves were taken. The GaSb cells were found to degrade slightly less than typical GaAs cells under electron irradiation, and calculations from spectral response curves showed that the damage coefficient for the minority carrier diffusion length was 3.5 times 10(exp 8). The cells degraded faster than GaAs cells under proton irradiation. However, researchers expect the top cell and coverglass to protect the GaSb cell from most damaging protons. Some annealing of proton damage was observed at low temperatures (80 to 160 C). Author

N91-30245*# SFA, Inc., Landover, MD.

TEMPERATURE COEFFICIENTS AND RADIATION INDUCED DLTS SPECTRA OF MOCVD GROWN n(+)p InP SOLAR CELLS **c44**

Robert J. Walters, Richard L. Statler, and Geoffrey P. Summers (Naval Research Lab., Washington, DC.) *In* NASA. Lewis Research Center, Space Photovoltaic Research and Technology Conference Aug. 1991 9 p Prepared in cooperation with Maryland Univ. Baltimore County, Catonsville (For primary document see N91-30203 22-20)

Avail: NTIS HC/MF A20 CSCL 10B

The effects of temperature and radiation on n(+)p InP solar cells and mesa diodes grown by metallorganic chemical vapor deposition (MOCVD) were studied. It was shown that MOCVD is capable of consistently producing good quality InP solar cells with Eff greater than 19 percent which display excellent radiation resistance due to minority carrier injection and thermal annealing. It was also shown that universal predictions of InP device performance based on measurements of a small group of test samples can be expected to be quite accurate, and that the degradation of an InP device due to any incident particle spectrum should be predictable from a measurement following a single low energy proton irradiation. Author

N91-30246*# Wayne State Univ., Detroit, MI. Dept. of Electrical and Computer Engineering.

ANNEALING CHARACTERISTICS OF AMORPHOUS SILICON ALLOY SOLAR CELLS IRRADIATED WITH 1.00 MeV PROTONS **c44**

Salman S. Abdulaziz and James R. Woodyard *In* NASA. Lewis Research Center, Space Photovoltaic Research and Technology Conference Aug. 1991 9 p (For primary document see N91-30203 22-20)

Avail: NTIS HC/MF A20 CSCL 10B

Amorphous Si:H and amorphous Si sub x, Ge sub (1-x):H solar cells were irradiated with 1.00 MeV proton fluences in the range of 1.00E14 to 1.25E15 cm (exp -2). Annealing of the short circuit current density was studied at 0, 22, 50, 100, and 150 C. Annealing times ranged from an hour to several days. The measurements confirmed that annealing occurs at 0 C and the initial characteristics of the cells are restored by annealing at 200 C. The rate of annealing does not appear to follow a simple nth order reaction rate model. Calculations of the short-circuit current density using quantum efficiency measurements and the standard AM1.5 global spectrum compare favorably with measured values. It is proposed that the degradation in J sub sc with irradiation is due to carrier recombination through the fraction of D (o) states bounded by the quasi-Fermi energies. The time dependence of the rate of annealing of J sub sc does appear to be consistent with the interpretation that there is a thermally activated dispersive transport mechanism which leads to the passivation of the irradiation induced defects. Author

N91-30247*# Aerospace Corp., Los Angeles, CA.

THE ADVANCED SOLAR CELL ORBITAL TEST

D. C. Marvin and M. Gates (Boeing Co., Seattle, WA.) *In* NASA. Lewis Research Center, Space Photovoltaic Research and Technology Conference Aug. 1991 3 p (For primary document see N91-30203 22-20)

Avail: NTIS HC/MF A20 CSCL 10B

The motivation for advanced solar cell flight experiments is

discussed and the Advanced Solar Cell Orbital Test (ASCOT) flight experiment is described. Details of the types of solar cells included in the test and the kinds of data to be collected are given. The orbit will expose the cells to a sufficiently high radiation dose that useful degradation data will be obtained in the first year. Author

N91-30248*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
LOW EARTH ORBITAL ATOMIC OXYGEN MICROMETEOROID, AND DEBRIS INTERACTIONS WITH PHOTOVOLTAIC ARRAYS
Bruce A. Banks, Sharon K. Rutledge, and Kim K. deGroh *In its* Space Photovoltaic Research and Technology Conference Aug. 1991 10 p (For primary document see N91-30203 22-20)
Avail: NTIS HC/MF A20 CSCL 10B

Polyimide Kapton solar array blankets can be protected from atomic oxygen in low earth orbit if SiO sub x thin film coatings are applied to their surfaces. The useful lifetime of a blanket protected in this manner strongly depends on the number and size of defects in the protective coatings. Atomic oxygen degradation is dominated by undercutting at defects in protective coatings caused by substrate roughness and processing rather than micrometeoroid or debris impacts. Recent findings from the Long Duration Exposure Facility (LDEF) and ground based studies show that interactions between atomic oxygen and silicones may cause grazing and contamination problems which may lead to solar array degradation. Author

N91-30249*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
LEO SPACE PLASMA INTERACTIONS
Dale C. Ferguson *In its* Space Photovoltaic Research and Technology Conference Aug. 1991 11 p (For primary document see N91-30203 22-20)
Avail: NTIS HC/MF A20 CSCL 10B

Photovoltaic arrays interact with the low earth orbit (LEO) space plasma in two fundamentally different ways. One way is the steady collection of current from the plasma onto exposed conductors and semiconductors. The relative currents collected by different parts of the array will then determine the floating potential of the spacecraft. In addition, these steady state collected currents may lead to sputtering or heating of the array by the ions or electrons collected, respectively. The second kind of interaction is the short time scale arc into the space plasma, which may deplete the array and/or spacecraft of stored charge, damage solar cells, and produce EMI. Such arcs only occur at high negative potentials relative to the space plasma potential, and depend on the steady state ion currents being collected. New high voltage solar arrays being incorporated into advanced spacecraft and space platforms may be endangered by these plasma interactions. Recent advances in laboratory testing and current collection modeling promise the capability of controlling, and perhaps even using, these space plasma interactions to enable design of reliable high voltage space power systems. Some of the new results may have an impact on solar cell spacing and/or coverslide design. Planned space flight experiments are necessary to confirm the models of high voltage solar array plasma interactions. Finally, computerized, integrated plasma interactions design tools are being constructed to place plasma interactions models into the hands of the spacecraft designer. Author

N91-30250*# Wayne State Univ., Detroit, MI. Dept. of Electrical and Computer Engineering.
THIN FILM CELL DEVELOPMENT WORKSHOP REPORT
James R. Woodyard *In* NASA. Lewis Research Center, Space Photovoltaic Research and Technology Conference Aug. 1991 12 p (For primary document see N91-30203 22-20)
Avail: NTIS HC/MF A20 CSCL 10B

The Thin Film Development Workshop provided an opportunity for those interested in space applications of thin film cells to debate several topics. The unique characteristics of thin film cells as well as a number of other issues were covered during the discussions. The potential of thin film cells, key research and development issues, manufacturing issues, radiation damage, substrates, and space qualification of thin film cells were discussed. Author

N91-30251*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
WORKSHOP SUMMARY: SPACE ENVIRONMENTAL EFFECTS
A. Meulenberg (Communications Satellite Corp., Clarksburg, MD.) and B. E. Anspaugh *In* NASA. Lewis Research Center, Space Photovoltaic Research and Technology Conference Aug. 1991 21 p (For primary document see N91-30203 22-20)
Avail: NTIS HC/MF A20 CSCL 10B

The workshop on Space Environmental Effects is summarized. The underlying concern of the group was related to the question of how well laboratory tests correlate with actual experience in space. The discussion ranged over topics pertaining to tests involving radiation, atomic oxygen, high voltage plasmas, contamination in low earth orbit, and new environmental effects that may have to be considered on arrays used for planetary surface power systems. Author

N91-30252*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
PRELIMINARY PERFORMANCE AND LIFE EVALUATIONS OF A 2-kW ARCJET
W. Earl Morren and Francis M. Curran 1991 31 p Presented at the 27th Joint Propulsion Conference, Sacramento, CA, 24-27 Jun. 1991; sponsored by AIAA, SAE, ASME, and ASEE Previously announced as A91-45796
(NASA-TM-105149; E-6430; NAS 1.15:105149; AIAA-91-2228)
Copyright Avail: NTIS HC/MF A03 CSCL 21H

The first results of a program to expand the operational envelope of low-power arcjets to higher specific impulse and power levels are presented. The performance of a kW-class laboratory model arcjet thruster was characterized at three mass flow rates of a 2:1 mixture of hydrogen and nitrogen at power levels ranging from 1.0 to 2.0 kW. This same thruster was then operated for a total of 300 h at a specific impulse and power level of 550 s and 2.0 kW, respectively, in three continuous 100-h sessions. Thruster operation during the three test segments was stable, and no measurable performance degradation was observed during the test series. Substantial cathode erosion was observed during an inspection following the second 100-h test segment. Most notable was the migration of material from the center of the cathode tip to a ring around a large crater. The anode sustained no significant damage during the endurance test segments. Some difficulty was encountered during start-up after disassembly and inspection following the second 100-h test segment, which caused constrictor erosion. This resulted in a reduced flow restriction and arc chamber pressure, which in turn caused a reduction in the arc impedance. Author

N91-30253# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
ANALYSIS OF ELECTROTHERMAL THRUSTERS M.S. Thesis [ANALISE DE PROPULSORES ELETROTERMICOS]
Fernando deSouzaCosta 1991 128 p In PORTUGUESE, ENGLISH summary
(INPE-5240-TDI/440) Avail: NTIS HC/MF A07

The performance of electrothermal thrusters is discussed and, particularly, the performance of augmented hydrazine catalytic thrusters. The influence of the mass of the power system, the thrust level, and the propellant on the mass efficiency of the propulsion systems for a certain mission are investigated. The influence of the power and tank pressure on the performance of an augmented catalytic thruster is determined. A number of electrothermal systems, some of them under development, is analyzed. The materials and the problems found in the construction of such systems are studied. Author

N91-30254*# Lockheed Space Operations Co., Titusville, FL.
LIQUID ROCKET BOOSTER INTEGRATION STUDY. VOLUME 1: EXECUTIVE SUMMARY Final Report

Nov. 1988 22 p
(Contract NAS10-11475)
(NASA-CR-188762; NAS 1.26:188762; LSO-000-286-1410-Vol-1)
Avail: NTIS HC/MF A03 CSCL 21H

The impacts of introducing liquid rocket booster engines (LRB) into the Space Transportation System (STS)/Kennedy Space Center (KSC) launch environment are identified and evaluated. Proposed ground systems configurations are presented along with a launch site requirements summary. Prelaunch processing scenarios are described and the required facility modifications and new facility requirements are analyzed. Flight vehicle design recommendations to enhance launch processing are discussed. Processing approaches to integrate LRB with existing STS launch operations are evaluated. The key features and significance of launch site transition to a new STS configuration in parallel with ongoing launch activities are enumerated. This volume is the executive summary of the five volume series. Author

N91-30255*# Lockheed Space Operations Co., Titusville, FL.
LIQUID ROCKET BOOSTER INTEGRATION STUDY. VOLUME 2: STUDY SYNOPSIS Final Report
Nov. 1988 206 p
(Contract NAS10-11475)
(NASA-CR-188763; NAS 1.26:188763; LSO-000-286-1410-Vol-2)
Avail: NTIS HC/MF A10 CSCL 21H

The impacts of introducing liquid rocket booster engines (LRB) into the Space Transportation System (STS)/Kennedy Space Center (KSC) launch environment are identified and evaluated. Proposed ground systems configurations are presented along with a launch site requirements summary. Prelaunch processing scenarios are described and the required facility modifications and new facility requirements are analyzed. Flight vehicle design recommendations to enhance launch processing are discussed. Processing approaches to integrate LRB with existing STS launch operations are evaluated. The key features and significance of launch site transition to a new STS configuration in parallel with ongoing launch activities are enumerated. This volume is the study summary of the five volume series. Author

N91-30256*# Lockheed Space Operations Co., Titusville, FL.
LIQUID ROCKET BOOSTER INTEGRATION STUDY. VOLUME 3, PART 1: STUDY PRODUCTS Final Report
Nov. 1988 450 p
(Contract NAS10-11475)
(NASA-CR-188764; NAS 1.26:188764;
LSO-000-286-1410-Vol-3-Pt-1) Avail: NTIS HC/MF A19 CSCL 21H

The impacts of introducing liquid rocket booster engines (LRB) into the Space Transportation System (STS)/Kennedy Space Center (KSC) launch environment are identified and evaluated. Proposed ground systems configurations are presented along with a launch site requirements summary. Prelaunch processing scenarios are described and the required facility modifications and new facility requirements are analyzed. Flight vehicle design recommendations to enhance launch processing are discussed. Processing approaches to integrate LRB with existing STS launch operations are evaluated. The key features and significance of launch site transition to a new STS configuration in parallel with ongoing launch activities are enumerated. This volume is part one of the study products section of the five volume series. Author

N91-30257*# Lockheed Space Operations Co., Titusville, FL.
LIQUID ROCKET BOOSTER INTEGRATION STUDY. VOLUME 3: STUDY PRODUCTS. PART 2: SECTIONS 8-19 Final Report
Nov. 1988 406 p
(Contract NAS10-11475)
(NASA-CR-188765; NAS 1.26:188765; LSO-000-286-1410) Avail: NTIS HC/MF A18 CSCL 21H

The impacts of introducing liquid rocket booster engines (LRB) into the Space Transportation System (STS)/Kennedy Space Center (KSC) launch environment are identified and evaluated. Proposed ground systems configurations are presented along with a launch site requirements summary. Prelaunch processing scenarios are described and the required facility modifications and new facility requirements are analyzed. Flight vehicle design recommendations to enhance launch processing are discussed. Processing approaches to integrate LRB with existing STS launch operations are evaluated. The key features and significance of launch site transition to a new STS configuration in parallel with ongoing launch activities are enumerated. This volume is part two of the study products section of the five volume series. Author

N91-30258*# Lockheed Space Operations Co., Cocoa Beach, FL.
LIQUID ROCKET BOOSTER INTEGRATION STUDY. VOLUME 4: REVIEWS AND PRESENTATION MATERIAL Final Report
Nov. 1988 959 p
(Contract NAS10-11475)
(NASA-CR-188766; NAS 1.26:188766; LSO-000-286-1410) Avail: NTIS HC/MF A99 CSCL 21H

Liquid rocket booster integration study is presented. Volume 4 contains materials presented at the MSFC/JSC/KSC Integrated Reviews and Working Group Sessions, and the Progress Reviews presented to the KSC Study Manager. The following subject areas are covered: initial impact assessment; conflicts with the on-going STS mission; access to the LRB at the PAD; the activation schedule; transition requirements; cost methodology; cost modelling approach; and initial life cycle cost. Author

N91-30259*# Lockheed Space Operations Co., Titusville, FL.
LIQUID ROCKET BOOSTER INTEGRATION STUDY. VOLUME 5, PART 1: APPENDICES Final Report
Nov. 1988 256 p
(Contract NAS10-11475)
(NASA-CR-188767; NAS 1.26:188767;
LSO-000-286-1410-Vol-5-Pt-1) Avail: NTIS HC/MF A12 CSCL 21H

The impacts of introducing liquid rocket booster engines (LRB) into the Space Transportation System (STS)/Kennedy Space Center (KSC) launch environment are identified and evaluated. Proposed ground systems configurations are presented along with a launch site requirements summary. Prelaunch processing scenarios are described and the required facility modifications and new facility requirements are analyzed. Flight vehicle design recommendations to enhance launch processing are discussed. Processing approaches to integrate LRB with existing STS launch operations are evaluated. The key features and significance of launch site transition to a new STS configuration in parallel with ongoing launch activities are enumerated. This volume is the appendices of the five volume series. Author

N91-30260*# Auburn Univ., AL. Solid State Sciences Center.
SRB SEAWATER CORROSION PROJECT Final Report
M. J. Bozack Jul. 1991 83 p
(Contract NAS8-38800)
(NASA-CR-184188; NAS 1.26:184188) Avail: NTIS HC/MF A05 CSCL 21H

The corrosion behavior of 2219 aluminum when exposed to seawater was characterized. Controlled corrosion experiments at three different temperatures (30, 60 and 100 C) and two different environments (seawater and 3.5 percent salt solution) were designed to elucidate the initial stages in the corrosion process. It was found that 2219 aluminum is an active catalytic surface for growth of Al2O3, NaCl, and MgO. Formation of Al2O3 is favored at lower temperatures, while MgO is favored at higher temperatures. Visible corrosion products are formed within 30 minutes after seawater exposure. Corrosion characteristics in 3.5 percent salt solution are different than corrosion in seawater. Techniques utilized were: (1) scanning electron microscopy, (2) energy dispersive x-ray spectroscopy, and (3) Auger electron spectroscopy. Author

N91-30261*# Thiokol Corp., Brigham City, UT. Space Operations.
TECHNICAL EVALUATION MOTOR NO. 7 (TEM-07) Interim Report
Phil Hugh 8 Feb. 1991 93 p

(Contract NAS8-30490)
(NASA-CR-184186; NAS 1.26:184186; TWR-61561) Avail: NTIS HC/MF A05 CSCL 21H

Technical Evaluation Motor Number 7 (TEM-7) was a full scale, full-duration static test firing of a high performance motor (HPM) configuration solid rocket motor (SRM) with nozzle vectoring. The static test fire occurred on 11 December 1990 at the Thiokol Corporation Static Test Bay T-97. Documented here are the procedures, performance, and results available through 22 January 1991. Critical post test hardware activities and assessment of the test data are not complete. A completed test report will be submitted 60 days after the test date. Included here is a presentation and discussion of the TEM-7 performance, anomalies, and test result concurrence with the objectives outlined in CTP-0107 Revision A, Space Shuttle Technical Evaluation Motor number 7 (TEM-07) Static Fire Test Plan. Author

N91-30262*# Thiokol Corp., Brigham City, UT. Space Operations.
FLIGHT SET 360L007 (STS-33R) CASE AND SEALS, VOLUME 2 Final Report
Alan R. Carlisle Feb. 1991 84 p
(Contract NAS8-30490)
(NASA-CR-184184; NAS 1.26:184184; TWR-17546-Vol-2) Avail: NTIS HC/MF A05 CSCL 21H

The performance of the 360L007, Seventh Flight, redesigned Solid Rocket Motors (RSRM) is assessed with respect to case hardware and joint sealing issues as seen from post-flight assessment of the case and seals. Potential anomalies are classified and summarized. The post-flight assessment of both motors showed the case segments to be in good condition. Field joint fretting indications on this flight set ranged from none on one joint through light (less than 0.003 inch deep) on most of the joints to locally medium (greater than 0.003, less than 0.005 inch deep) on two joints. No new fretting was found in old fretting locations. All fretting was mapped from the inner clevis leg. The capture feature fretting was not mapped due to the difficulty of measuring the fretting in the capture feature region, but it is assumed that the capture feature had similar damage as the inner clevis leg. Post-flight assessment of both motors showed the seal components to be in good condition. Author

N91-30263*# Thiokol Corp., Brigham City, UT. Space Operations.
FLIGHT MOTOR SET 360T004 (STS-30R). VOLUME 1: SYSTEM OVERVIEW Final Report
Glenn A. Ricks Sep. 1989 169 p
(Contract NAS8-30490)
(NASA-CR-184187; NAS 1.26:184187; TWR-17543-1-Vol-1; Publ-90089) Avail: NTIS HC/MF A08 CSCL 21H

The fourth NASA space shuttle flight incorporating redesigned solid rocket motors began on 4 May 1989. The flight motors were designated 360Q004A (left-hand) and 360H004B (right-hand); the mission was designated STS-30R. Overall engine performance was excellent. The low sample rate data that was available showed exceptional propulsion performance. All ballistic and mass property parameters closely matched the predicted values and were well within the required contract end item specification levels that could be assessed. No strain, vibration, or aft skirt heating environments could be addressed due to developmental flight instrumentation deletion. Infrared readings from the shuttle thermal imager were considered very good when compared with ground environment instrumentation readings taken during both the aborted and the actual countdowns. However, hand-held infrared gun reading/ground environment instrumentation comparisons were considered poor during both countdowns, with the exception of the T - 3 hour timeframe during the actual launch. Postflight inspection again verified superior performance of the insulation, phenolics, metal parts, and seals. All combustion gas was contained by the insulation in the field and case-to-nozzle joints. Inadequate parachute performance on the left-hand booster caused high splashdown loads, which resulted in a displaced nozzle and factory joint weatherseal unbond anomalies. Recommendations were made concerning improved thermal modeling and instruments. The rationale for these recommendations, the dispositions of all anomalies, and complete result details are given. Author

N91-30264*# Thiokol Corp., Brigham City, UT. Space Operations.
AFT SEGMENT DOME-TO-STIFFENER FACTORY JOINT INSULATION VOID ELIMINATION Final Report, Mar. 1991
S. K. Jensen Mar. 1991 30 p
(Contract NAS8-30490)
(NASA-CR-184185; NAS 1.26:184185; TWR-61241) Avail: NTIS HC/MF A03 CSCL 21H

Since the detection of voids in the internal insulation of the dome-to-stiffener factory joint of the 15B aft segment, all aft segment dome-to-stiffener factory joints were x-rated and all were found to contain voids. Using a full-scale process simulation article (PSA), the objective was to demonstrate that the proposed changes in the insulation layup and vacuum bagging processes will greatly reduce or eliminate voids without adversely affecting the configuration of performance of the insulation which serves as a primary seal over the factory joint. The PSA-8 aft segment was insulated and cured using standard production processes.
Author

N91-30265*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
ON PROTECTION OF FREEDOM'S SOLAR DYNAMIC RADIATOR FROM THE ORBITAL DEBRIS ENVIRONMENT. PART 2: FURTHER TESTING AND ANALYSES
Jennifer L. Rhatigan, Eric L. Christiansen, and Michael L. Fleming (LTV Missiles and Electronics Group, Dallas, TX.) 1991 11 p Proposed for presentation at the International Solar Energy Conference, Lahaina, Maui, HI, 4-8 Apr. 1992; sponsored by ASME
(NASA-TM-104514; E-6335; NAS 1.15:104514) Avail: NTIS HC/MF A03 CSCL 21H

Presented here are results of a test program undertaken to further define the response of the solar dynamic radiator to hypervelocity impact (HVI). Tests were conducted on representative radiator panels (under ambient, nonoperating conditions) over a range of velocity. Target parameters are also varied. Data indicate that analytical penetration predictions are conservative (i.e., pessimistic) for the specific configuration of the solar dynamic radiator. Test results are used to define the solar dynamic radiator reliability with respect to HVI more rigorously than previous studies. Test data, reliability, and survivability results are presented.
Author

N91-30266*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
DESCRIPTION OF THE CONTROL SYSTEM DESIGN FOR THE SSF PMAD DC TESTBED
Anastacio N. Baez and Greg L. Kimnach 1991 10 p Presented at the 26th Intersociety Energy Conversion Engineering Conference, Boston, MA, 4-9 Aug. 1991; sponsored by ANS, SAE, ACS, AIAA, ASME, IEEE, and AIChE
(NASA-TM-105202; E-6505; NAS 1.15:105202) Avail: NTIS HC/MF A02 CSCL 21H

The Power Management and Distribution (PMAD) DC Testbed Control System for Space Station Freedom was developed using a top down approach based on classical control system and conventional terrestrial power utilities design techniques. The design methodology includes the development of a testbed operating concept. This operating concept describes the operation of the testbed under all possible scenarios. A unique set of operating states was identified and a description of each state, along with state transitions, was generated. Each state is represented by a unique set of attributes and constraints, and its description reflects the degree of system security within which the power system is operating. Using the testbed operating states description, a functional design for the control system was developed. This functional design consists of a functional outline, a text description, and a logical flowchart for all the major control

system functions. Described here are the control system design techniques, various control system functions, and the status of the design and implementation. Author

N91-30267*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
TEST AND EVALUATION OF LOAD CONVERTER TOPOLOGIES USED IN THE SPACE STATION FREEDOM POWER MANAGEMENT AND DISTRIBUTION DC TEST BED
Ramon C. Lebron, Angela C. Oliver, and Robert F. Bodi (Analytical Engineering Corp., North Olmsted, OH.) 1991 9 p Presented at the 26th Intersociety Energy Conversion Engineering Conference, Boston, MA, 4-9 Aug. 1991; cosponsored by the ANS, SAE, ACS, AIAA, ASME, IEEE, and AIChE
(NASA-TM-105217; E-6532; NAS 1.15:105217) Avail: NTIS HC/MF A02 CSCL 21H

Power components hardware in support of the Space Station Freedom dc Electrical Power System were tested. One type of breadboard hardware tested is the dc Load Converter Unit, which constitutes the power interface between the electric power system and the actual load. These units are dc to dc converters that provide the final system regulation before power is delivered to the load. Three load converters were tested: a series resonant converter, a series inductor switchmode converter, and a switching full-bridge forward converter. The topology, operation principles, and tests results are described, in general. A comparative analysis of the three units is given with respect to efficiency, regulation, short circuit behavior (protection), and transient characteristics. Author

23 CHEMISTRY AND MATERIALS (GENERAL)

No abstracts in this category.

24 COMPOSITE MATERIALS

Includes physical, chemical, and mechanical properties of laminates and other composite materials.
For ceramic materials see *27 Nonmetallic Materials.*

N91-30268# Massachusetts Inst. of Tech., Cambridge. Lab. for Advanced Composites.
STATIC AND DYNAMIC PROPERTIES OF COMPOSITE BLADES WITH STRUCTURAL COUPLINGS Final Report, 1 Feb. 1987 - 30 Jun. 1990
John Dugundji 27 Aug. 1990 10 p
(Contract DAAL03-87-K-0024)
(AD-A229318; TELAC-90-15; ARO-24023.5-EL) Avail: NTIS HC/MF A02 CSCL 11/4

The static and dynamic behavior of helicopter rotor blades made of composite materials is studied experimentally and analytically. A new analytic model was developed for handling arbitrarily large deflections of composite blades based on an Euler angle representation. Results for both large static deflections and small amplitude vibrations about the large static deflections, agreed well with experimental results from a series of structurally coupled composite blade models constructed to verify the analysis. The analytical model was later extended to include large amplitude, nonlinear vibrations about the large static positions. It was found that both static deflections and large amplitudes influenced greatly the fore-and-aft (lead-lag) and torsion modes, but had little effect on the bending modes. GRA

N91-30269# Technion Research and Development Foundation Ltd., Haifa (Israel).
PARTICULATE CERAMIC MATRIX COMPOSITES FOR HIGH STRAIN-RATE PERFORMANCE Final Technical Report, Dec. 1983 - Aug. 1990
D. G. Brandon, Y. Yeshurun, L. Baum, M. Farkash, and N. Shafry Aug. 1990 34 p
(Contract DAJA45-88-C-0007)
(AD-A229364; R/D-5544-MS-01) Avail: NTIS HC/MF A03 CSCL 11/2

Oxynitride glasses have promising dynamic properties for ballistic applications, notably both a high impedance and a high Hugoniot elastic limit (HEL). The compatibility of these glasses with nonoxide filler materials was investigated, in particular their reaction with B4C, TiB2, and SiC. Only SiC was found to be inert at the glass forming temperature, and 50 mm diameter samples for planar impact experiments were hot pressed with approx. 50 wt pct. 600 grit SiC powder. These samples contained less than 2 pct. porosity. The filler powder was completely wetted by the glass matrix and homogeneously dispersed in the matrix. No traces of crystalline phases other than SiC were detected. Both the static and the dynamic mechanical properties were determined. The ballistic impedance was approximately that expected from the law of mixtures, while the HEL was close to that of the parent glass. GRA

N91-30270 Illinois Univ., Urbana-Champaign.
STRUCTURE AND PROPERTIES OF TITANIUM NITRIDE-STRENGTHENED MICROLAMINATE METAL MATRIX COMPOSITES Ph.D. Thesis
John Howard Givens 1990 270 p
Avail: Univ. Microfilms Order No. DA9114245

The structure and properties of titanium nitride strengthened microlaminate metal matrix composites are examined. Reactive ion plated titanium nitride (TiN) was deposited onto titanium, nickel, and aluminum foils which were subsequently hot pressed to form microlaminate composites. The TiN volume percent was varied and its effect upon the structure and properties of the composites investigated. Scanning electron microscopy (SEM), cross sectional transmission electron microscopy (TEM), and scanning Auger electron spectroscopy (AES) were used to characterize the film morphology, the fracture behavior of the composites, and the nature of the metal/ceramic interfaces formed during reactive ion plating and hot pressing. The mechanical properties of the microlaminate composite were determined by tensile testing specimens machined from the hot pressed composites. Correlation between the microstructures, mechanical properties, and processing parameters are presented. Dissert. Abstr.

N91-30271*# Mississippi State Univ., Mississippi State.
PROCEEDINGS OF THE 7TH SEMIANNUAL MEETING OF THE NOZZLE INITIATIVE INDUSTRY ADVISORY COMMITTEE ON STANDARDIZATION OF CARBON-PHENOLIC TEST METHODS AND SPECIFICATIONS
William B. Hall, comp., Pat C. Pinoli, comp., and Cindy G. Upton, comp. (National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.) 1 Aug. 1991 303 p Meeting held in Alpharetta, GA, 16-17 May 1991
(Grant NAG8-545)
(NASA-CR-188720; NAS 1.26:188720) Avail: NTIS HC/MF A14 CSCL 11D

The application of carbon fibers and fabrics (CF) for producing rocket nozzles is discussed. These materials which are essential for fabricating the carbon composites used in aerospace systems gasify when exposed to high temperatures and the mechanical properties of the composites degrade. The oxidation kinetics under isothermal (IC) and non-isothermal (NIC) conditions are examined and a comparison is made between the characteristics of IC and NIC oxidation. Several CF, chars, and carbon blacks were examined, including a microporous char, a graphitized rayon fabric, and several carbonized rayon fabrics. A summary is given of the advantages and drawbacks of isothermal and non-isothermal

oxidation of carbons. The proceedings are assembled in the form of a roundtable discussion. M.G.

N91-30272# Oak Ridge National Lab., TN.
DEVELOPMENT OF HIGH-DENSITY FIBER-REINFORCED SILICON CARBIDE FCVI COMPOSITES
Y. G. Roman (Centre for Technical Ceramics, Einhoven, Netherlands), D. P. Stinton, and T. M. Besmann 1991 8 p Presented at the 8th Meeting of European Chemical Vapor Deposition (EURO CVD), Glasgow, Scotland, 8-13 Sep. 1991
(Contract DE-AC05-84OR-21400)
(DE91-012531; CONF-9109156-1) Avail: NTIS HC/MF A02

The objective is to determine conditions for optimum (uniform) matrix distribution for forced-flow chemical vapor infiltration (FCVI) produced silicon carbide composites. In particular, the effect of the thermal gradient across the preform and the densification time on composite overall density and density gradients were investigated. DOE

N91-30273# Los Alamos National Lab., NM.
TEXTURE DEVELOPMENT IN Cu-W COMPOSITES
W. J. Poole, J. D. Embury, U. F. Kocks, and R. E. Bolmaro (Universidad Nacional de Rosario, Argentina) 1991 8 p Presented at the 12th Riso International Symposium on Metallurgy and Materials Science, Metal Matrix Composites: Processing, Microstructure and Properties, Rosario (Argentina), 2-6 Sep. 1991
(Contract W-7405-eng-36)
(DE91-013388; LA-UR-91-1733; CONF-9109159-1) Avail: NTIS HC/MF A02

A model system of polycrystalline Cu containing continuous fibers of W has been deformed in plane strain compression so that the imposed flow occurred perpendicular to the fiber axis. A technique has been developed to grid the sample to examine the detailed distribution of strain around the fibers. In addition, texture measurements have been conducted to compare the behavior of the composite with that of unreinforced copper of similar grain size. These observations allow the texture components which arise due to the constraints exerted by the fibers to be related to the flow pattern imposed by the fibers. DOE

N91-30274*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
LOCAL DELAMINATION IN LAMINATES WITH ANGLE PLY MATRIX CRACKS. PART 2: DELAMINATION FRACTURE ANALYSIS AND FATIGUE CHARACTERIZATION
T. Kevin OBrien Jun. 1991 57 p
(NASA-TM-104076; NAS 1.15:104076;
AVSCOM-TR-91-B-011-Pt-2) Avail: NTIS HC/MF A04 CSCL 11D

Constant amplitude tension-tension fatigue tests were conducted on AS4/3501-6 graphite/epoxy (02/ theta sub 2/ -(theta sub 2))sub s laminates, where theta was 15, 20, 25, or 30 degrees. Fatigue tests were conducted at a frequency of 5 Hz and an R-ratio of 0.1. Dye penetrant enhanced x-radiography was used to document the onset of matrix cracking in the central -(theta) degree plies, and the subsequent onset of local delaminations in the theta/ -(theta) interface at the intersection of the matrix cracks and the free edge, as a function of the number of fatigue cycles. Two strain energy release rate solutions for local delamination from matrix cracks were derived: one for a local delamination growing from an angle ply matrix crack with a uniform delamination growing from an angle ply matrix crack with a triangular shaped delamination area that extended only partially into the laminate width from the free edge. Plots of G(max) vs. N were generated to assess the accuracy of these G solutions. The influence of residual thermal and moisture stresses on G were also quantified. However, a detailed analysis of the G components and a mixed-mode fatigue failure criterion for this material may be needed to predict the fatigue behavior of these laminates. Author

N91-30275*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
CONSTANT AMPLITUDE AND POST-OVERLOAD FATIGUE CRACK GROWTH BEHAVIOR IN PM ALUMINUM ALLOY AA 8009
A. P. Reynolds Aug. 1991 32 p
(NASA-TM-104132; NAS 1.15:104132) Avail: NTIS HC/MF A03 CSCL 11D

A recently developed, rapidly solidified, powder metallurgy, dispersion strengthened aluminum alloy, AA 8009, was fatigue tested at room temperature in lab air. Constant amplitude/constant delta kappa and single spike overload conditions were examined. High fatigue crack growth rates and low crack closure levels compared to typical ingot metallurgy aluminum alloys were observed. It was proposed that minimal crack roughness, crack path deflection, and limited slip reversibility, resulting from ultra-fine microstructure, were responsible for the relatively poor da/dN-delta kappa performance of AA 8009 as compared to that of typical IM aluminum alloys. Author

N91-30276 Council for National Academic Awards (England).
THE SIMULATION OF FLUID FLOW PROCESSES USING VECTOR PROCESSORS Ph.D. Thesis
Constantinos Savvas Ierotheou 1990 306 p
Avail: Univ. Microfilms Order No. BRDX91995

The potential gains in vectorization of linear and nonlinear systems of equations are investigated. Previous studies carried out on the suitability of algorithms for vectorization have been based on the solution of Poisson's equation. In accordance with this, a range of algorithms are explored and compared using a VA-1 pipeline processor attached to a MASSCOMP MC5400. Analysis shows that almost full vectorization is possible leading to speed-up factors of up to 90. Based on these results the vectorized conjugate gradient with a Jacobi preconditioner (JCGV) is the best of the algorithms considered. The development of a two-dimensional fluid flow code is described which is used to solve the Navier-Stokes equations, SIMPLE is implemented to handle the non-linear nature of the equations. The first two problems are isothermal flows, viz, the moving lid cavity and the sudden expansion in a duct problem. A study of where the greatest computational effort is expended, the subsequent vectorization leads to 98 percent of SIMPLE being modified. This results in speed-up factors of 6 for the cavity problem and 29 for the sudden expansion problem. In both problems the JCGV is marginally faster than the vectorized Jacobi with under-relaxation (JURV). However, the JCGV algorithm is not robust and it is necessary to relax carefully the approximation, otherwise high computation times or divergence is likely. Two further problems are considered each with increasing complexity: scalar quantities of temperature and characteristics of k-epsilon turbulence. The potential gains in vectorization of the SIMPLE family on pipeline architectures clearly demonstrated that such efforts on practical CFD codes should be well rewarded with regard to processor performance.
Dissert. Abstr.

N91-30277 California Univ., Los Angeles.
SPECTROSCOPIC STUDIES OF GRAPHITE EROSION IN HYDROGEN AND OXYGEN PLASMAS Ph.D. Thesis
Junju Ra 1991 161 p
Avail: Univ. Microfilms Order No. DA9117384

Chemical sputtering of graphite due to the bombardment of hydrogen and oxygen ions with tokamak edge-like parameters is studied spectroscopically. First, a spectroscopic diagnostic technique was developed. During that effort, basic spectroscopic data was obtained for hydrocarbons and carbon-oxides, compounds that are representative products of chemical sputtering by hydrogen and oxygen. Evidence was found for chemical sputtering by hydrogen and oxygen. An oxygen plasma reactor was constructed using a helicon wave plasma source. The Nagoya type-III antenna is used to excite the plasma at the frequency of 13.56 MHz. An oxygen plasma, 5 cm in diameter, having a density of 1 times 10 (exp 12) cm (exp-3) and an electron temperature of 10 eV is achieved with an rf power of 600 watts at a pressure of 1 mtoor.

The magnetic field is found to play an important role in plasma generation. Last, using a developed spectroscopic measurement technique and a rf plasma reactor, chemical sputtering yields are measured at tokamak boundary-like plasma conditions. In the case of hydrogen-induced erosion, it is found that chemical sputtering is a dominant erosion process below 800 C in the high ion flux condition, in spite of the reduction of the yield. Dissert. Abstr.

N91-30278 Stanford Univ., CA.
DAMAGE IN GRAPHITE-EPOXY LAMINATED COMPOSITES DUE TO LOW-VELOCITY IMPACT Ph.D. Thesis
Hyung Yun Choi 1991 192 p
Avail: Univ. Microfilms Order No. DA9115751

An analytical and experimental investigation was performed to study the impact damage in graphite/epoxy laminated composites caused by a low-velocity foreign object. The impact damage comprising of matrix cracking and delaminations embedded inside the materials was the primary concern of the study. Because of the complexity of such damage in terms of failure mechanism and failure mode, this research was divided into two sequential steps: (1) fundamental study of impact damage mechanisms and mechanics, and (2) development of an analytical model for predicting impact damage. In order to accomplish the study, a unique impact test facility was designed and developed. The major characteristic of the tester is the design of a rectangular barrel so that the impactor can be designed in two parts: a base and a nose. Accordingly, different types of impact damage can be produced by appropriately selecting the nose shape of the impactor. To study impact damage mechanisms and mechanics, line-nose impactors were selected which can considerably simplify impact damage from a complicated three dimensional pattern to a two-dimensional one. As a result, a new set of test data was generated from T300/976 graphite/epoxy composites. An analytical model as well as a computer code 2DIMPACT were also developed for analyzing the results of line-loading impact damage. Accordingly, the experimental findings combined with the analytical results produced a sufficient understanding of impact damage mechanisms and mechanics of laminated composites. The governing parameters controlling the impact damage mechanisms and mechanics were identified. Based on knowledge gained from the line-loading impact study, an analytical model was developed for predicting the initiation and the extent of the damage in laminated composites resulting from three dimensional point-nose impact. A matrix failure criterion was proposed for predicting the initiation of the impact damage, and a delamination growth criterion was proposed for estimating the extent of the delaminations in laminated composites.
Dissert. Abstr.

N91-30279# Lynntech, Inc., Bryan, TX.
OXIDATION AND WEAR RESISTANT CARBON-CARBON COMPOSITES Final Report, 1 Oct. 1990 - 30 Apr. 1991
Richard O. Corden, Carlos E. Salinas, Oliver J. Murphy, and G. D. Hitchens 30 May 1991 41 p
(Contract DAAL03-90-C-0016)
(AD-A238475; ARO-28256.1-MS-SBI) Avail: NTIS HC/MF A03 CSCL 11/4

Widespread application of carbon carbon composites has been restricted by their low oxidation resistance at elevated temperatures. A major barrier to the development of protective ceramic coatings for these materials is the lack of experimental methods of depositing adherent, crack-free, protective ceramic deposits with high deposition rates in a cost-effective manner. The objective of this project is to develop dense, adherent, electrophoretically deposited ceramic coatings on carbon-carbon composites, giving rise to enhanced oxidation resistance and wear resistance. Ceramic materials, coating additives and methods for bonding and densifying the selected materials have been identified. A broad range of ceramic materials were successfully deposited on carbonaceous substrates from a non-aqueous deposition bath using electrophoresis. Deposited ceramic layers were bonded using either polymeric binders of organometallic compounds or inorganic phosphate-based binders. Attempts to densify the ceramic coatings were unsuccessful. GRA

N91-30280*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
RESIDUAL THERMAL AND MOISTURE INFLUENCES ON THE STRAIN ENERGY RELEASE RATE ANALYSIS OF LOCAL DELAMINATIONS FROM MATRIX CRACKS
T. K. OBrien Jul. 1991 29 p Prepared in cooperation with Army Aviation Systems Command, Hampton, VA
(NASA-TM-104077; NAS 1.15:104077; AVSCOM-TR-91-B-012)
Avail: NTIS HC/MF A03 CSCL 11D

An analysis utilizing laminated plate theory is developed to calculate the strain energy release rate associated with local delaminations originating at off-axis, single ply, matrix cracks in laminates subjected to uniaxial loads. The analysis includes the contribution of residual thermal and moisture stresses to the strain energy released. Examples are calculated for the strain energy release rate associated with local delaminations originating at 90 degrees and angle-ply (non-90 degrees) matrix ply cracks in glass epoxy and graphite epoxy laminates. The solution developed may be used to assess the relative contribution of mechanical, residual thermal, and moisture stresses on the strain energy release rate for local delamination for a variety of layups and materials.
Author

N91-30281*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
INTERPHASE LAYER OPTIMIZATION FOR METAL MATRIX COMPOSITES WITH FABRICATION CONSIDERATIONS
M. Morel, D. A. Saravanos (Case Western Reserve Univ., Cleveland, OH.), and C. C. Chamis 1991 23 p Presented at the 36th International SAMPE Symposium and Exhibition, San Diego, CA, 15-18 Apr. 1991
(NASA-TM-105166; E-6457; NAS 1.15:105166) Avail: NTIS HC/MF A03 CSCL 11D

A methodology is presented to reduce the final matrix microstresses for metal matrix composites by concurrently optimizing the interphase characteristics and fabrication process. Application cases include interphase tailoring with and without fabrication considerations for two material systems, graphite/copper and silicon carbide/titanium. Results indicate that concurrent interphase/fabrication optimization produces significant reductions in the matrix residual stresses and strong coupling between interphase and fabrication tailoring. The interphase coefficient of thermal expansion and the fabrication consolidation pressure are the most important design parameters and must be concurrently optimized to further reduce the microstresses to more desirable magnitudes. Author

N91-30282*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
THE EFFECTS OF INTERPLY DAMPING LAYERS ON THE DYNAMIC RESPONSE OF COMPOSITE STRUCTURES
D. A. Saravanos (Case Western Reserve Univ., Cleveland, OH.) and C. C. Chamis 1991 28 p Presented at the 32nd Structures, Structural Dynamics and Materials Conference, Baltimore, MD, 8-10 Apr. 1991; cosponsored by the AIAA, ASME, ASCE, AHS, and ASC Previously announced in IAA as A91-32064
(NASA-TM-104497; E-6355; NAS 1.15:104497) Avail: NTIS HC/MF A03 CSCL 11D

Integrated damping mechanics for composite laminates with constrained interlaminar layers of polymer damping materials are developed. Discrete layer damping mechanics are presented for composite materials with damping layers, in connection with a semi-analytical method for predicting the modal damping in simply-supported specialty composite plates. Several application cases are used to demonstrate the advantages of the method. Damping predictions for graphite-epoxy composite plates of various laminations demonstrate the potential for higher damping than geometrically equivalent aluminum plates. The effects of aspect ratio, damping layer thickness, and fiber volume ratio on static and dynamic characteristics of the composite plate are also investigated. Author

N91-30283 Defence Research Establishment Pacific, Victoria (British Columbia).
HIGH RESOLUTION ULTRASONIC IMAGING OF DISBONDS IN ADHESIVELY BONDED COMPOSITE STRUCTURES
Ken I. McRae Mar. 1989 25 p
(DREP-89-06; CTN-91-60183) Avail: NTIS HC A03

Composite and metallic structural components may be joined by a variety of techniques and adhesive bonding techniques are being increasingly utilized within the aerospace industry. The detection of disbonds in adhesively bonded joints and the detection of delaminations in composite materials constitute similar ultrasonic imaging problems in that the characteristic flaw in each case is a planar void. The information derived from the two usual ultrasonic imaging methods, B- and C-scan, may be used to determine both the flaw depth in the specimen and the area of the flaw. Signal processing techniques are applied to determine both the amplitude and the polarity of each discrete reflection. Examples of each imaging method are presented for a three-dimensional data set obtained from a graphite/epoxy (Gr/Ep)-titanium interface containing simulated disbonds. The importance of concurrently displaying amplitude and polarity information is demonstrated.
Author (CISTI)

N91-30284 Defence Research Establishment Pacific, Victoria (British Columbia).
THE EFFECTS OF SUNLIGHT AND HUMIDITY ON CF-188 COMPOSITE RESIN
G. A. Luoma and R. D. Rowland Apr. 1989 24 p
(DREP-89-07; CTN-91-60184) Avail: NTIS HC A03

Fibre reinforced thermoset composites are gaining increased usage in military equipment. In particular, the CF-188 aircraft has approximately 40 percent of its skin composed of Hercules AS3501-6 carbon fibre reinforced epoxy resin. This material is, therefore, likely to be exposed to environmental extremes. Previous studies indicated that reflectance Fourier transform infrared spectroscopy could be used to determine the degree of resin degradation caused by the combined effects of heat, water, and ultraviolet light. The present report discusses studies on the individual effects of water and light on the chemical structure of this resin system. The results indicate that ultraviolet light exposure causes a rapid and specific type of surface degradation, while the water exposure causes a slower and more random polymer degradation.
Author (CISTI)

N91-30285# Royal Aerospace Establishment, Farnborough (England). Composites Research Advisory Group.
CRAG WORKING GROUP ON ALTERNATIVE/EQUIVALENT MATERIALS FOR COMPONENTS CLEARED PRIMARILY BY STRUCTURAL TESTING
24 Jan. 1991 16 p
(RAE-TM-Mat/Str-1159; BR300166; ETN-91-99858) Copyright Avail: NTIS HC/MF A03

Conclusions and recommendations of the CRAG working group on alternative/equivalent materials for components cleared primarily by structural testing are described. The relationship between the following are considered: constituents and ply properties, ply and laminate properties; laminate properties and structural elements/features. Research about failure criteria, through-thickness properties; physicochemical properties, impact, creep and fatigue is detailed.
ESA

N91-30286# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Zentrallab.
MANUFACTURING AND MECHANICAL PROPERTIES OF FIBER COMPOSITE MATERIALS WITH TEXTILE PREFORMS [FERTIGUNG UND MECHANISCHE EIGENSCHFTEN VON FASERVERBUNDWERKSTOFFEN MIT TEXTILEN VORFORMLINGEN]
J. Brandt, K. Drechsler, H. F. Siegling, and F. J. Arendts (Stuttgart Univ., Germany, F.R.) 1990 23 p In GERMAN Presented at the 23rd Internationale AVK-Tagung, Mainz, Fed. Republic of Germany, 5-7 Nov. 1990
(MBB-Z-0325-90-PUB; OTN-030839; ETN-91-99453) Avail: NTIS HC/MF A03

The potential of different fiber structures is shown, using examples from various fields. An automobile engine bearer was obtained with a three dimensional glass fiber tissue, by which a marked improvement of crash behavior and a more rational fabrication were obtained. A carbon/carbon airfoil leading edge for a hypersonic aircraft was realized with integral stiffening ribs, using a three dimensional carbon fiber tissue. The problems raised by the joining of deck coating and stiffening ribs were solved. It is shown that textile fiber preforms offer a great potential for the optimization of the mechanical properties and the simplification of the fabrication of fiber composite materials.
ESA

N91-30287# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Zentrallab.
MICROFRACTOGRAPHY OF FIBER REINFORCED COMPOSITE MATERIALS [MIKROFRAKTOGRAPHIE AN FASERVERSTAERKTEN VERBUNDWERKSTOFFEN]
H. E. Franz 1990 13 p In GERMAN
(MBB-Z-0326-90-PUB; OTN-030840; ETN-91-99454) Avail: NTIS HC/MF A03

The type of load, the type of rupture, the local crack progress direction, and the rupture outlet, are obtained at the time of forced rupture. Statements are made on fiber matrix linkage and moisture effect. Oscillation ruptures occur only as delamination ruptures. Oscillation streaks can appear in matrix resin at the place of fibers, and between fibers. They may also appear at the interface. The oscillation streak morphologies depend on the type of fiber, the matrix resin, and the laminated texture.
ESA

N91-30288# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Zentrallab.
THERMAL ANALYSIS FOR THE EXAMINATION AND DETERMINATION OF PROCESSING CONDITIONS FOR STRUCTURAL FIBER COMPOSITE MATERIALS AND BONDING AGENTS IN AIR AND SPACE NAVIGATION [THERMOANALYSE ZUR UNTERSUCHUNG UND FESTLEGUNG VON VERARBEITUNGSBEDINGUNGEN FUER STRUKTURPREPREGS UND -KLEBER IN DER LUFT- UND RAUMFAHRT]
K. Schmidtke, A. Keller, and D. Feulner 1990 13 p In GERMAN Presented at Fachtagung FH-Wuerzburg 'Angewandte Instrumentelle Analytik fuer Formmassen aus polymeren Werkstoffen, Wuerzburg, Fed. Republic of Germany, 17-21 Sep. 1990
(MBB-Z-0344-90-PUB; OTN-030932; ETN-91-99456) Avail: NTIS HC/MF A03

The utilization fields of thermoanalytic methods for synthetic material processing of high performance structural components made of fiber composite materials in air and space flight are described using selected examples: Differential Scanning Calorimetry (DSC) for checking the shelf/shop life, and for determining cure cycle and post cure; a combination of DSC and Thermal Gravimetric Analysis (TGA) results for determining temperature limits. High loaded primary structural components made of composite materials with synthetic matrix are used in a series of products: Airbus rudder unit, helicopter cabin and rotor system, solar generator for satellites and fighter wings.
ESA

N91-30289# Technische Univ., Berlin (Germany, F.R.). Inst. fuer Luft- und Raumfahrt.
THE HYBRID CONSTRUCTION SYSTEMS: A CONTRIBUTION TO THE POSSIBILITIES OF WEIGHT REDUCING FOR METAL DISK FRAMEWORKS BY UNIDIRECTIONAL FIBER REINFORCEMENT [HYBRIDBAUWEISEN: BEITRAG ZU DEN MOEGLICHKEITEN DER GEWICHTSREDUZIERUNG VON METALLISCHEN SCHEIBENTRAGWERKEN DURCH UNIDIREKTIONALE FASER-VERSTAERKUNG]
Georg W. Mair and J. Wiedemann 1991 110 p In GERMAN
(ILR-Mitt-254(1991); ETN-91-99462) Avail: NTIS HC/MF A06

When exclusively linear elastic material behavior is required, material and weight saving is made possible by hybridation

dependent on load ratio and elongation. If the maximum load limit to be considered, e.g., the total rupture, may be defined as a static rupture, the possibilities of weight saving are much higher. Wall thickness optimization is based on static failure breakdown. When various failure forms are to be considered for a construction, it is necessary to examine whether these types of failure are to be avoided with the same degree of safety. If it is not the case, weight is saved by a redundant construction, above all when the construction behaves as damage tolerant with regard to fail safe design, so that safety of dependability can be lowered, in opposition to a partial rupture. ESA

N91-30290# Institut National des Sciences Appliquees, Lyon (France).
CONTRIBUTION TO THE STUDY OF MAGNESIUM CEMENTS AND THEIR EVALUATION AS THE MATRIX FOR GLASS FIBER REINFORCED COMPOSITE MATERIALS Ph.D. Thesis [CONTRIBUTION A L'ETUDE DES CIMENTS MAGNESIENS ET A LEUR VALORISATION COMME MATRICE DE MATERIAUX COMPOSITES RENFORCES DE FIBRES DE VERRE]
Philippe Matray 1990 227 p In FRENCH; ENGLISH summary
(ISAL-90-0051; ETN-91-99474) Avail: NTIS HC/MF A11

A bibliographic study is presented for magnesium cements, glass fibers, glass cement composites, and fabric reinforced composites. Water stability of magnesium matrix is verified experimentally. The physical mechanical properties and the durability of the glass reinforced matrix are investigated and compared to those of a Pilkington type glass reinforced composite. Matrix properties can be improved by increasing the magnesium/magnesium chloride solution ratio and by using a fluidifying additive of organosilane type. The effect of the additive on matrix and composite properties are examined. The glass fabric reinforcement of magnesium matrix is reported. The realization of semiindustrial prototypes and their characterization by mechanical tests are described. Results are confirmed by computation in the field of composite material mechanisms. ESA

N91-30291# National Aerospace Lab., Amsterdam (Netherlands). Structures and Materials Div.
DAMAGE TOLERANCE PROPERTIES OF NEW CARBON COMPOSITES
W. G. J. tHart and R. H. W. M. Frijns Feb. 1989 10 p Presented at International Conference on Evolution of Advanced Materials, Milan, Italy, 31 May - 2 Jun. 1989
(Contract NIVR-01705N/03505N)
(NLR-TP-89032-U; ETN-91-99638) Avail: NTIS HC/MF A02

Sensitivity of composites to defects is important for design allowables. Manufacturers of new composite systems claim improved resistance to defects. The damage tolerance properties of some recently developed carbon composites were evaluated. Defect sensitivity was investigated by impact tests on compression preloaded quasi-isotropic laminates. After damage characterization post impact compression test provided quantitative information on impact damage resistance. Tension compression fatigue tests were conducted on notched (plus or minus 45, 0(2), 90, 0(2))(s) laminates to study the resistance to damage growth under cyclic loading. Fatigue performance was considered in terms of damage growth after specific fatigue intervals as established by ultrasonic C scanning, rather than a simple time to failure criterion. ESA

25 INORGANIC AND PHYSICAL CHEMISTRY

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics.*.

N91-30292# Denver Univ., CO. Dept. of Chemistry.
PHYSICAL CHEMISTRY OF ENERGETIC NITROGEN COMPOUNDS Final Report, 1 May 1987 - 30 Apr. 1990
Robert D. Coombe 8 Nov. 1990 38 p
(Grant AF-AFOSR-0210-87)
(AD-A229480; AFOSR-90-1162TR) Avail: NTIS HC/MF A03
CSCL 07/3

This program has produced detailed information concerning the chemical behavior of halogen isocyanate, halogen amine, and halogen azide systems. These types of molecules can store considerable amounts of energy, which can be released by photolysis, chemical reaction, or energy transfer processes. In a number of the particular cases studied, the energy release was strongly constrained by angular momentum conservation rules. The data obtained are relevant to the development of new laser systems, new propellants, and the understanding of combustion processes. GRA

N91-30293# TRW Space Technology Labs., Redondo Beach, CA.
INITIATION AND MODIFICATION OF REACTION BY ENERGY ADDITION: KINETIC AND TRANSPORT PHENOMENA Final Report, 1 Sep. 1988 - 1 Sep. 1990
F. E. Fendell, M. S. Chou, T. J. Zukowski, and G. F. Carrier 1 Oct. 1990 149 p
(Contract F49620-87-C-0081)
(AD-A229591; AFOSR-90-1140TR) Avail: NTIS HC/MF A07
CSCL 07/5

Laboratory experiments, supplemented by approximate theoretical studies, have been carried out on the photochemical ignition of a flowing homogeneous gaseous fuel-oxidizer premixture by nonintrusive energy addition. In the experimental task, we have successfully demonstrated the ignition of H2/O2 and CH4/O2 mixtures with photolysis of NH3 by use of an ArF laser at 193 nm. The theory, by a combination of numerical and approximate analytic methods, examines the interaction of premixture stoichiometry, preferential diffusion (i.e., differing diffusivities for heat and species), and flame radius, with respect to the outward propagation of a laminar flame from a single spheroidal kernel (if a flame develops). Previously reported observations of the variation of the flame-front speed with flame radius, sometimes interpreted in terms of preferential-diffusion effects but probably better interpreted in terms of radiative heat loss, have been examined; the need exists for further spherical-flame-propagation experiments, with emphasis on measurements taken when the flame radius is more nearly comparable to the flame thickness. GRA

N91-30294*# New Mexico Univ., Albuquerque. Dept. of Chemical and Nuclear Engineering.
AN INVESTIGATION OF VOIDS FORMATION MECHANISMS AND THEIR EFFECTS ON FREEZE AND THAW PROCESSES OF LITHIUM AND LITHIUM FLUORIDE Final Report, May 1989 - Jan. 1991
Mohamed S. El-Genk and Jae-Young Yang Aug. 1991 116 p
(Grant NAG3-1045)
(NASA-CR-188707; NAS 1.26:188707) Avail: NTIS HC/MF A06
CSCL 07D

The mechanisms of void formation during the cooldown and freezing of lithium coolant within the primary loop of SP-100 type systems are investigated. These mechanisms are: (1) homogeneous nucleation; (2) heterogeneous nucleation; (3) normal segregation of helium gas dissolved in liquid lithium; and (4) shrinkage of lithium during freezing. To evaluate the void formation potential due to segregation, a numerical scheme that couples the freezing and mass diffusion processes in both the solid and liquid regions is developed. The results indicated that the formation of He bubbles is unlikely by either homogeneous or heterogeneous nucleation during the cooldown process. However, homogeneous nucleation of He bubbles following the segregation of dissolved He in liquid lithium ahead of the solid-liquid interface is likely to occur. Results also show that total volume of He void is insignificant when compared to that of shrinkage voids. In viewing this, the subsequent research focuses on the effects of shrinkage void forming during freezing of lithium on subsequent thaw processes are investigated using a numerical scheme that is based on a single (solid/liquid) cell approach. The cases of lithium-fluoride are also investigated to show the effect of larger volume shrinkage

upon freezing on the freeze and thaw processes. Results show that a void forming at the wall appreciably reduces the solid-liquid interface velocity, during both freeze and thaw, and causes a substantial rise in the wall temperature during thaw. However, in the case of Li, the maximum wall temperature was much lower than the melting temperature of PWC-11, which is used as the structure material in the SP-100 system. Hence, it is included that a formation of hot spots is unlikely during the startup or restart of the SP-100 system. Author

N91-30295 Harvard Univ., Cambridge, MA.
PHASE TRANSITIONS IN SOLID HYDROGEN AT MEGABAR PRESSURES Ph.D. Thesis
Hector Efrain Lorenzana 1990 122 p
Avail: Univ. Microfilms Order No. DA9113190

Solid H2 was studied using Raman scattering in a diamond anvil cell up to pressures of 167 GPa and from temperatures of 4.3 to 150 K. The observation is reported of the orientationally ordered phase in para-H2 at 1.1 megabars and 8 K. New results are also presented about the recently observed transition by Hemley and Mao at 77 K and 1.5 megabars in an approx. 50 pct. ortho-para mixture. It is shown that, contrary to expectations, the new phase is not the continuation of the low pressure orientationally ordered phase. This new phase called hydrogen-A (H-A) was determined to exist only at high pressures. Other interesting properties include orientationally ordering transitions within the H-A phase and apparent insensitivity of the phase line to the ortho-para concentration. Lastly, evidence is presented indicating that the H-A phase line will have a critical point at a pressure of about 173 GPa and 151 K. Dissert. Abstr.

N91-30296 Nottingham Univ. (England).
SPARK IGNITION ENGINE COMBUSTION PROCESS ANALYSIS Ph.D. Thesis
Marc William Wiseman 1989 250 p
Avail: Univ. Microfilms Order No. BRD-92004

Cylinder pressure analysis is widely used in the experimental investigation of gasoline engine combustion processes. A pressure record can be processed to reveal details of charge burning, which is a good indicator of combustion quality. The evaluation of an approximate technique for calculating the charge mass fraction burnt, a novel approach for determining heat loss to the block, the development of an online combustion analysis system and the investigation of the correlation between 50 percent burn location and MBT are discussed. A detailed examination was carried out into the uncertainties in the mass fraction burnt evaluation method as suggested by Rassweller and Withrow. A revised procedure was developed which was does not require a priori identification of the combustion end point, and new approach is suggested to calculate the polytropic indices necessary for the pressure processing. This particular implementation is able to identify the late burning and misfiring cycles, and then take appropriate steps to ensure their proper analysis. The problems associated with the assumption of uniform pressure, TDC alignment, pressure sampling rate, clearance volume estimation and calibrating the acquired pressure to absolute are also evaluated. A novel and simple method is developed to ascertain, directly from the pressure history, the heat loss to the cylinder block. Both experimental and simulated data are used to support the accuracy of the suggested heat loss evaluation, and the sensitivity of the method to its inputs is examined. The conversion of combustion analysis procedures into a format suitable for undertaking high speed analysis is described. The analysis system has been used to study the potentially beneficial correlation between 50 percent burn location and MBT. The correlation is examined in detail, and found to be valid except under lean fueling conditions, which is seen to be caused by slow flame initiation. It is suggested that the 50 percent burn location can be used as an ignition timing calibration reference setting, and as an indicator of combustion chamber performance. A simple engine simulation was employed to verify that changes in burn shape account for the small variation seen in the optimum 50 percent burn locations encountered in different engines.
Dissert. Abstr.

N91-30297# TSI Mason Research Inst., Worcester, MA. Biochemistry Dept.
SURFACE-BOUND ALKYL MONOLAYERS: ELECTROCHEMICAL AND STRUCTURAL CHARACTERIZATION
Nancy W. Downer, Jianguo Li, Leslie W. DeLuca, Elizabeth M. Penniman, and H. G. Smith 6 Jun. 1991 28 p
(Contract N00014-88-C-0193)
(AD-A237604; TSIMRI-4193-5; TR-5) Avail: NTIS HC/MF A03 CSCL 06/5

Two substrates that are amenable to analogous silane chemistry provided the basis for characterizing alkylsilane layers formed by octadecyltrichlorosilane (OTS) and dimethyloctadecylchlorosilane (DMOCS) reactions. Electrochemical analysis of the capacitance was used to measure an apparent thickness, d(A), and the degree of surface coverage, 0, for deposited silane layers on Si/SiO2 electrodes. Elemental analysis was performed to determine the carbon load resulting from comparable silane reactions on glass bead substrates. Glass bead substrates were also examined by FTIR spectroscopy to evaluate the hydrocarbon incorporation and hydration of surface silanol groups. A semiquantitative measure of hydrocarbon deposition was derived from FTIR spectra and shown to correlate well with the electrochemical and analytical data over a defined range. GRA

N91-30298# TSI Mason Research Inst., Worcester, MA. Biochemistry Dept.
SURFACE-BOUND BIOMEMBRANES INCORPORATING RECEPTORS: ELECTROCHEMICAL AND STRUCTURAL CHARACTERIZATION
Nancy W. Downer, Jianguo Li, Elizabeth M. Penniman, and H. G. Smith 6 Jun. 1991 30 p
(Contract N00014-88-C-0193)
(AD-A237605; TSIMRI-4193-6; TR-6) Avail: NTIS HC/MF A03 CSCL 06/5

A method is described for forming stable surface-bound structures that incorporate membrane receptors in a lipid bilayer environment. These structures were formed by dialysis of detergent-solubilized biomembranes in the presence of two alkylsilanated substrates: Si/SiO2 and glass beads. Electrochemical analysis of the capacitance was used to determine an apparent thickness and the degree of surface coverage at each stage in the deposition process. Similarly, elemental analysis on glass beads was used to quantitate the carbon load. Glass beads substrates were also examined by FTIR spectroscopy to evaluate the alkylsilanated substrate before and after dialysis. GRA

N91-30299# TSI Mason Research Inst., Worcester, MA. Biochemistry Dept.
EVALUATION OF SURFACE-BOUND MEMBRANES WITH ELECTROCHEMICAL IMPEDANCE SPECTROSCOPY
Nancy W. Downer, Jianguo Li, and H. G. Smith 6 Jun. 1991 41 p
(Contract N00014-88-C-0193)
(AD-A237606; TSIMRI-4193-4; TR-4) Avail: NTIS HC/MF A03 CSCL 06/5

Membrane structures containing the visual receptor protein, rhodopsin, were formed by detergent dialysis on platinum, silicon oxide, titanium oxide, and indium/tin oxide electrodes. Electrochemical impedance spectroscopy was used to evaluate the biomembrane structures and their electrical properties. A model equivalent circuit is proposed to describe the membrane electrode interface. The data suggest that the surface structure is a relatively complete single membrane bilayer with a coverage of 0.97, and with longterm stability. GRA

N91-30300# Rockwell International Corp., Canoga Park, CA. Rocketdyne Div.
RESEARCH IN INORGANIC FLUORINE CHEMISTRY Final Report, 1 Apr. 1988 - 31 Mar. 1991
K. O. Christe, W. W. Wilson, C. J. Schack, E. C. Curtis, and R. D. Wilson 28 May 1991 266 p

(Contract DAAL03-88-C-0005)
(AD-A238348; ARO-24929.20-CH) Avail: NTIS HC/MF A12 CSCL 07/4

Although a major effort of oxidizer chemistry is the development of new oxidizers of increased oxidizer strength, no quantitative methods existed until now to either define, measure or compute the strength of an oxidizer, the only data available were some isolated observations that some oxidizers were capable of fluorinating a given substrate while others were not. However, even these qualitative data were inconsistent because it was impossible to distinguish whether the failure of an attempted oxidative fluorination was due to an insufficient oxidizer strength or poorly chosen reaction conditions or excessively high activation energy barriers. GRA

N91-30301# ORD, Inc., North Salem, NH.
RECEPTOR BASED FIBER OPTIC MICROSENSOR DEVELOPMENT Final Report, Aug. 1988 - Aug. 1990
Steve J. Lackie May 1991 63 p
(Contract DAAA15-88-C-0026)
(AD-A238491; CRDEC-CR-105) Avail: NTIS HC/MF A04 CSCL 17/8

Detection of chemicals and toxins in multi-component mixtures has previously required a knowledge of the identity of the species to be detected and expensive, time consuming analytical procedures. By focusing on the physiological targets (receptors, antibodies, and enzymes), which these agents attack, it is possible to have detection of classes of compounds without these restraints. This is achieved by coupling an optically tagged recognition site (e.g., receptor) to the surface of a fiber optic waveguide (FOWG) and taking advantage of the interaction between the optical tag and the evanescent wave effect of the FOWG. The binding of a toxin to the receptor alters the fluorescence of the tag, hence the amount of light conveyed by FOWG to a detector. In this report, we describe the critical features of a receptor-based biosensor: immobilization of receptor proteins; coupling of fluorescent tags to the receptor; development of a rugged, replaceable sample chamber assembly; and the design of a hardened optical system. GRA

N91-30302# Cornell Univ., Ithaca, NY. School of Chemical Engineering.
THERMODYNAMICS OF THE LIQUID MIXTURE CARBON DIOXIDE + BUTANE BELOW 285 K
Edward J. Hall, Henrique J. R. Guedes, and John A. Zollweg Mar. 1991 42 p
(Contract GRI-5086-260-1313)
(PB91-185009; GRI-91/0088) Avail: NTIS HC/MF A03 CSCL 07D

Carbon dioxide and butane are frequently encountered as minor components of natural gas. These will liquefy first as it is cooled, so a knowledge of their vapor-liquid equilibrium data below 250 K is available in the literature. Models of phase equilibrium can be expressed in terms of the excess Gibbs Free Energy, and the temperature dependence of the excess Gibbs Free Energy is related to the excess enthalpy. Thus, measurements of excess enthalpy may be combined with phase equilibrium measurements to produce a model that gives reliable vapor-liquid carbon dioxide were performed at two temperatures below 250 K in a flow calorimeter. A maximum likelihood method was used to combine these calorimetric results with available vapor-liquid equilibrium data to produce a model of the nonideality in this system that gives much more reliable estimates of the phase equilibrium pressures, compositions, and enthalpies than had been available before. GRA

N91-30303# Cornell Univ., Ithaca, NY.
THERMODYNAMICS OF THE LIQUID MIXTURE KRYPTON + XENON UP TO 190 K
John A. Zollweg Mar. 1991 46 p
(Contract GRI-5086-260-1313)
(PB91-185025; GRI-91/0089) Avail: NTIS HC/MF A03 CSCL 07D

Mixtures of krypton and xenon are especially useful for testing theories treating the thermodynamics of liquid mixtures, because the interatomic potentials for the elements are simpler than the intermolecular potentials that are necessary to describe the interactions in a mixture of molecular fluids. When comparing a simple theory with experimental data, it is hard to know what to make of disagreements between the two, because the theories rest on a number of approximations both about the potential energy of interaction between species and about the thermodynamic consequences of intermolecular phenomena. Of all the mixtures of nonradioactive noble gases, krypton and xenon, exist as liquids at the highest temperatures, so they are easiest to study. The purpose of the report is to review the vapor-liquid equilibrium and excess enthalpy data for the system and to construct an empirical model that provides a reasonable summary of the experimental results. In the course of developing the model, an improved mathematical method for performing nonlinear parameter estimation by the maximum likelihood method was discovered. It is also briefly described. GRA

N91-30304# Pennsylvania State Univ., University Park. Dept. of Mechanical Engineering.
OXIDES OF NITROGEN EMISSIONS FROM TURBULENT HYDROCARBON/AIR JET DIFFUSION FLAMES Annual Report, Jan. - Dec. 1990
S. R. Turns and F. H. Myhr Jan. 1991 69 p
(Contract GRI-5086-260-1308)
(PB91-184952; PSU-ME-R-90/91-0005; GRI-91/0090) Avail: NTIS HC/MF A04 CSCL 21B

Measurements of oxides of nitrogen emission indices, flame radiant fractions, and visual flame dimensions were made for turbulent jet diffusion flames covering a wide range of flow conditions. The objectives of the study were to understand the interrelationships among nitrogen oxide emissions, flow conditions, and flame radiation, and to provide a well-characterized data base to guide modeling efforts. A range of radiant fractions, and hence characteristic flame temperatures, were obtained by varying fuel type. Test results are consistent with, but do not prove, the view that the bulk of the nitrogen oxides emitted by jet flames is formed in the high temperature, nearly stoichiometric, large-scale eddies at the flame tip. Dissert. Abstr.

N91-30305*# National Inst. of Standards and Technology, Gaithersburg, MD.
EXPERIMENTAL THERMAL CONDUCTIVITY, THERMAL DIFFUSIVITY, AND SPECIFIC HEAT VALUES FOR MIXTURES OF NITROGEN, OXYGEN, AND ARGON Final Report
R. A. Perkins and M. T. Cieszkiewicz May 1991 65 p Sponsored in part by NASA. Lewis Research Center, and by AF
(NASA-CR-188769; NAS 1.26:188769; PB91-194472; NISTIR-3961) Avail: NTIS HC/MF A04 CSCL 07D

Experimental measurements of thermal conductivity and thermal diffusivity obtained with a transient hot-wire apparatus are reported for three mixtures of nitrogen, oxygen, and argon. Values of the specific heat, Cp, are calculated from these measured values and the density calculated with an equation of state. The measurements were made at temperatures between 65 and 303 K with pressures between 0.1 and 70 MPa. The data cover the vapor, liquid, and supercritical gas phases for the three mixtures. The total reported points are 1066 for the air mixture (78.11 percent nitrogen, 20.97 percent oxygen, and 0.92 percent argon), 1058 for the 50 percent nitrogen, 50 percent oxygen mixture, and 864 for the 25 percent nitrogen, 75 oxygen mixture. Empirical thermal conductivity correlations are provided for the three mixtures. Author

N91-30306 Prins Maurits Lab. TNO, Rijswijk (Netherlands).
CRITERIA FOR CONFIRMATION OF CHEMICAL WARFARE AGENTS IDENTIFICATION Final Report
E. R. J. Wils Dec. 1990 16 p
(Contract A85/D/114)
(PML-1990-79; TD-90-3665; ETN-91-99818) Copyright Avail: Prins Maurits Lab. TNO, P.O. Box 45, 2280 AA Rijswijk ZH, Netherlands

In order to ascertain the unambiguous identification of chemical warfare agents, a set of sampling and analytical criteria is established. The analytical criteria are based on spectrometric and chromotographic techniques arranged according to the amount of sample available. The criteria described are only applicable to compounds which are not naturally occurring such as organophosphorus nerve agents. For compounds such as toxins which are found in nature, additional criteria have to be fulfilled. ESA

N91-30307# Technische Univ., Berlin (Germany, F.R.). Fachbereich Physik.
ELECTRON SPECTROSCOPIC EXAMINATION OF Si(113) SURFACE Ph.D. Thesis [ELEKTRONENSPEKTROSKOPISCHE UNTERSUCHUNG DER Si(113)-OBERFLAECH]
Uwe Myler 1990 212 p In GERMAN
(ETN-91-99441) Avail: NTIS HC/MF A10

The electronic and geometric structure of Si (113) surface was examined, using three different methods. The clean surface was reconstructed. A surface photoelectronic voltage could be obtained by simultaneous cooling of the sample to 320 K and ultraviolet irradiation. Hydrogen adsorption gave two different covers. Water adsorption dissociated the H2O molecule in H and OH. The Si (113) surface was saturated by a 1.5 liter water dose at room temperature. None of the structural models proposed up to now for the Si (133) surface allowed the measurement result to be declared free from contradiction. ESA

N91-30308# Technische Univ., Berlin (Germany, F.R.). Fachbereich Elektrotechnik.
MICROTHERMAL CONDUCTIVITY SENSOR IN SILICON TECHNOLOGY FOR THE ANALYSIS OF BINARY AND TERNARY GAS MIXTURES Ph.D. Thesis [MIKROWAERMELEITFAEHIGKEITSSENSOR IN SILIZIUMTECHNOLOGIE FUER DIE ANALYSE VON ZWEI- UND DREIKOMPONENTIGEN GASGEMISCHEN]
Gerhard Pollak-Diener 1990 128 p In GERMAN
(ETN-91-99443) Avail: NTIS HC/MF A07

In comparison with existing measuring devices, the sensor is described as having small dimensions, a short operative response time, low power consumption, low drift, passivation against aggressive gases and low fabrication costs. Sensor fabrication is described. A modelized description of the sensor and computation using the finite difference method allow an exact adaptation of sensor structure to the measuring properties to be reached. The model developed allows the calculation of the static and dynamic behavior of the sensor and the calculation of gas exchange by diffusion. The computational results were checked using the sensor realized. Such a sensor is used in the iron and steel industry and in chemical industry where corrosive and explosive gas mixtures have to be analyzed. ESA

N91-30309*# Pennsylvania State Univ., University Park. Propulsion Engineering Research Center.
LASER INDUCED SPARK IGNITION OF METHANE-OXYGEN MIXTURES Final Technical Report
D. A. Santavicca, C. Ho, B. J. Reilly, and T.-W. Lee 25 Sep. 1991 18 p
(Grant NAG3-966)
(NASA-CR-188689; NAS 1.26:188689) Avail: NTIS HC/MF A03 CSCL 21B

Results from an experimental study of laser induced spark ignition of methane-oxygen mixtures are presented. The experiments were conducted at atmospheric pressure and 296 K under laminar pre-mixed and turbulent-incompletely mixed conditions. A pulsed, frequency doubled Nd:YAG laser was used as the ignition source. Laser sparks with energies of 10 mJ and 40 mJ were used, as well as a conventional electrode spark with an effective energy of 6 mJ. Measurements were made of the flame kernel radius as a function of time using pulsed laser shadowgraphy. The initial size of the spark ignited flame kernel was found to correlate reasonably well with breakdown energy as predicted by the Taylor spherical blast wave model. The subsequent growth rate of the flame kernel was found to increase with time from a value less than to a value greater than the adiabatic, unstretched laminar growth rate. This behavior was attributed to the combined effects of flame stretch and an apparent wrinkling of the flame surface due to the extremely rapid acceleration of the flame. The very large laminar flame speed of methane-oxygen mixtures appears to be the dominant factor affecting the growth rate of spark ignited flame kernels, with the mode of ignition having a small effect. The effect of incomplete fuel-oxidizer mixing was found to have a significant effect on the growth rate, one which was greater than could simply be accounted for by the effect of local variations in the equivalence ratio on the local flame speed. Author

N91-30210*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
HIGH RESOLUTION ELECTROLYTE FOR THINNING InP BY ANODIC DISSOLUTION AND ITS APPLICATIONS TO EC-V PROFILING, DEFECT REVEALING AND SURFACE PASSIVATION
Maria Faur, Mircea Faur, Irving Weinberg, Manju Goradia, and Carlos Vargas (Kent State Univ., OH.) *In its* Space Photovoltaic Research and Technology Conference Aug. 1991 12 p Prepared in cooperation with Cleveland State Univ., OH (For primary document see N91-30203 22-20)
Avail: NTIS HC/MF A20 CSCL 07D

N91-30214*# Aeronautical Systems Div., Wright-Patterson AFB, OH.
CALCULATION OF GALLIUM-METAL-ARSENIC PHASE DIAGRAMS
J. D. Scofield, J. E. Davison, A. E. Ray, and S. R. Smith (Dayton Univ., OH.) *In* NASA. Lewis Research Center, Space Photovoltaic Research and Technology Conference Aug. 1991 14 p (For primary document see N91-30203 22-20)
Avail: NTIS HC/MF A20 CSCL 07D

26 METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

N91-30310# Oak Ridge National Lab., TN.
MATERIAL BEHAVIOR DURING SOLID PARTICLE EROSION OF ANNEALED 1100 ALUMINUM
J. R. Keiser, D. F. Wilson, and M. Rao (Notre Dame Univ., IN.) 1990 13 p Presented at the 4th Conference on Fossil Energy Materials, Oak Ridge, 15-17 May 1990
(Contract DE-AC05-84OR-21400)
(DE90-012593; CONF-900546-8) Avail: NTIS HC/MF A03

One problem in fossil fuel conversion is the wear and erosion of equipment such as combustors. Studies were conducted to evaluate the response of annealed 1100 aluminum to single and multiple erosive particle impacts. The 30 degree incidence angle multiple particle part impact conditions ranged from that necessary to produce damage characteristics of the incubation period through that required to develop the steady state condition. Single impacts on samples were done at room temperature by spherical particles with an incidence angle of 30 degrees. A mechanical properties microprobe was used to measure the hardness at the bottom of the craters formed by single impacts and in the material below the craters. A characteristic ripple structure developed on the surface with increasing dose. For the incubation period samples, the increase of deformation of the subsurface layers was studied using tapersectioning techniques in conjunction with a mechanical properties microprobe while normal sectioning was used for the steady state samples. Distinct differences were observed in the hardness profiles beneath crests and valleys which form the ripple structure. DOE

N91-30311# Naval Air Development Center, Warminster, PA. Surface Interactions Research Lab.
PROCEEDINGS OF THE TRI-SERVICE CONFERENCE ON CORROSION
Vinod S. Agarwala 19 Oct. 1989 645 p Conference held in Atlantic City, 17-19 Oct. 1989
(AD-A229334; NADC-SIRLAB-1089) Avail: NTIS HC/MF A99
CSCL 11/6

This conference was held to develop new directions, and to highlight the awareness that the problems of corrosion in the military are far from over. There is a serious need for new approaches, methods, and products for aging weapon systems. Concepts like smart coatings, materials with artificial intelligence, sensors, and electric field or electronic barriers for corrosion protection will become the technology of tomorrow are needed. A wide variety of topics are covered such as organic and inorganic coatings, inhibitors, environmental assisted cracking, new materials, electronics, and EMI corrosion, measurement techniques, sensors and corrosion monitors, tribology, failure analysis, lessons learned, and others of general interest. Author

N91-30312 California Univ., Berkeley.
FATIGUE CRACK PROPAGATION IN AUSTENITIC STAINLESS STEELS AT CRYOGENIC TEMPERATURES Ph.D. Thesis
Zequn Mei 1990 109 p
Avail: Univ. Microfilms Order No. DA9103818

Fatigue crack propagation in austenitic stainless steels at cryogenic temperatures is discussed. The first part of the research concentrates on the influence of the mechanically induced martensitic transformation on the fatigue crack growth rate in metastable austenitic stainless steels. The steels 304L and 304LN were used to test the influence of composition; the testing temperatures 298 K and 77 K were used to study the influence of test temperature; and various load ratios were used to determine the influence of the mean stress. It was found that decreasing the mechanical stability of the austenite by changing composition or lowering temperature reduces the fatigue crack growth rate and increases the threshold stress intensity for crack growth. However, this beneficial effect diminishes as the load ratio increases, even though increasing the load ratio increases the extent of martensite transformation. Several mechanisms that may affect this phenomenon are discussed, including the perturbation of the crack-tip stress field, crack deflection, and the work hardening characteristics and relative brittleness of the transformed material. The perturbation of the stress field seems the most important; by modifying previous models, researchers developed quantitative analysis of the crack growth rate that provides a reasonable fit to the experimental results. The second part of the research concerns the effect of low temperature on fatigue crack propagation in 310 austenitic stainless steel. Crack growth rates were measured at 298 K, 77 K, and 4 K. As temperature decreased the fatigue crack growth rate decreased while the threshold stress intensity increased. At all three temperatures the fatigue crack propagated in a quasi-cleavage mode along a zigzag path. The propagating crack branched to an extent that increased as the temperature decreased. Since no martensite was detected on the crack surfaces and the crack surfaces were smoother at lower temperatures, neither transformation toughening nor roughness-induced crack closure can account for the temperature dependence of the crack growth rate. Various factors that might contribute to the temperature dependence are discussed.
Dissert. Abstr.

N91-30313# Brookhaven National Lab., Upton, NY.
EXAFS STUDY OF SPUTTERED Co/Al MULTILAYERS BY ELECTRON DETECTION: STRUCTURAL DIFFERENCE DUE TO DEPOSITION CONDITION
Jung Hoon Joo, Myung Hi Choi, Chung Keun Lee (SKC Ltd., Chonan, Republic of Korea), and Steve M. Heald 1991 5 p Presented at the 3rd Synchrotron Radiation User's Workshop, Pohany, Republic of Korea, 13-14 Apr. 1991
(Contract DE-AC02-76CH-00016)
(DE91-014787; BNL-46297; CONF-9104273-1) Avail: NTIS HC/MF A01

The EXAFS measurements and x-ray diffraction analysis have been made on magnetron sputtered Co-Al multilayers with modulation wavelengths of 1 to 2 monolayers and sputtering Ar gas pressure of 3 to 7 mTorr. X-ray diffraction results cannot clearly identify the phases present in the samples because the major diffraction peaks of different phases overlap. Preliminary analysis of the EXAFS data shows that Co atoms exist in two or more different phases, i.e., (alpha)-Co, CoAl(CsCl type), and possibly a solid solution of Co and Al with some Co atoms occupying the substitutional sites of fcc Al. DOE

N91-30314# North Carolina State Univ., Raleigh.
THE MICROSTRUCTURE AND CORROSION RESISTANCE OF ION IMPLANTED ALUMINUM-MOLYBDENUM ALLOYS CONTAINING THE PHASE Al12Mo
Ray B. Benson, Jr. 27 Feb. 1991 25 p
(Contracts DAAG29-79-D-1003; DAAG29-78-G-0022)
(AD-A238470; ARO-15489.3-MS) Avail: NTIS HC/MF A03
CSCL 11/6

For solid solution iron base alloys with chromium formed by either ion implantation or bulk melting, the corrosion behavior in aqueous chloride solution can be represented by potentiodynamic polarization measurements. This was established by comparing the potential-pH diagrams obtained to published Pourbaix diagrams of potential versus pH for the appropriate systems. Analytical electron microscopy revealed that continuous films of the phase Al12Mo with either a mottled, metastable microstructure or a granular, stable microstructure formed in aluminum annealed at selected temperatures after implantation with a maximum molybdenum concentration in the range of 8 to 10 atomic percent. The corrosion behavior of specimens containing either of these two types of continuous films with or an as-implanted microstructure was characterized in aqueous solutions with or without 0.1 molar chloride ion at pH6 or pH63 using potentiodynamic polarization techniques. GRA

N91-30315# Ames Lab., IA.
DEVELOPMENT OF A CENTRIFUGAL ATOMIZATION PROCESS FOR THE PRODUCTION OF LARGE SPHERICAL METAL POWDERS Ph.D. Thesis
K. Funke 30 May 1991 129 p
(Contract W-7405-eng-82)
(DE91-014500; IS-T-1561) Avail: NTIS HC/MF A07

A centrifugal atomization process was developed for the production of large spherical metal powders. The final design of the process incorporated a low speed rotating liquid bath (RLB) for the cooling of atomized molten metal droplets generated from an atomizing disk. Experiments were conducted in an open air system with pure Ag and with an alloy of Ag-15 wt percent Cu. Spherical powders were obtained in the case of pure Ag where there was no oxidation of the droplets. Use of silicone oil for the RLB was found to have a spheroidizing effect or irregular oxidized droplets of Ag-15 wt percent Cu. Microstructural examination of individual Ag-15 wt percent Cu particles revealed evidence of partitionless solidification around the rim of the particles. These partitionless rims were attributed to undercooling of the droplets caused by the high cooling rate imparted by the RLB. The average particle size of the pure Ag powders was closely controlled in the size range of 450 to 650 microns by controlling the speed of the atomizing disk. Results from particle size calculations suggested that the RLB did not cause any significant secondary disintegration of the atomized droplets. The size distributions of the powders were narrow with geometric standard deviations in the range of 1.4 to 1.6. The predominant atomization mode for these experiments was determined to be alignment disintegration. Even narrower size distributions are thought to be possible with the process if the atomization parameters could be modified to gain access to the direct drop formation regime. Specific recommendations are presented to accomplish this enhanced control of the atomization process. DOE

N91-30316 Toronto Univ. (Ontario). Dept. of Mechanical Engineering.
INVESTIGATION OF THE FATIGUE CRACK GROWTH CHARACTERISTICS OF Ti-17
D. McCammond and M. Nummi Jun. 1989 127 p
(Contract DREP-W7708-6700-01-SB)
(DREP-89-32; CTN-91-60181) Avail: NTIS HC A07

This report summarizes test results of fatigue crack growth rate experiments on corner crack specimens taken from a Ti-17 compressor disc forging. Ti-17 is a near beta titanium alloy developed for use in engine discs at intermediate operating temperatures. The data forms part of the Canadian contribution to the AGARD Structures and Materials Panel Program on damage tolerance of gas turbine engine discs. The test program consisted of low-cycle fatigue tests on corner crack specimens. Constant amplitude loading sequences involved ten different loading waveforms with two specimens being tested for each waveform. Tests were conducted from an initial crack length of 0.5 mm to a final length of 5 mm. The TURBISTAN spectrum, a standard load sequence for cold aircraft engine discs, was used to investigate fatigue crack growth under spectrum loading. In addition to the test program, a literature review on Ti-17 was carried out and the microstructure of seven compressor disc forging samples was investigated. The samples were found to be composed of about 70 percent Widmanstatten alpha-plates and 30 percent elongated primary alpha grains embedded in the Widmanstatten structure. CISTI

N91-30317# Oak Ridge National Lab., TN.
THE P/M PROCESSING AND APPLICATIONS OF Fe3Al-BASED INTERMETALLICS
V. K. Sikka, R. H. Baldwin, C. R. Howell, and J. H. Reinshagen (Ametek, Inc., Eighty Four, PA.) 1991 12 p Presented at the 1991 Powder Metallurgy Conference and Exhibition, Chicago, IL, 9-12 Jun. 1991
(Contract DE-AC05-84OR-21400)
(DE91-015309; CONF-9106244-1) Avail: NTIS HC/MF A03

The batch-to-batch reproducibility of an iron-aluminide alloy powder is described. Two batches of powders were produced by air-induction melting, followed by nitrogen-gas atomization. The powder reproducibility was checked for chemical composition, response to consolidation and fabrication, and mechanical properties. The second powder batch showed significantly different tensile properties from the first batch. The difference in properties of the second batch was explained by its lower aluminum content and higher oxygen content. As experience builds in the recovery of various elements during melting and standards for chemical analysis become established for these materials, the batch-to-batch variability is expected to be reduced to a minimum. DOE

N91-30318*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
EQUIVALENT CRYSTAL THEORY OF ALLOYS
Guillermo Bozzolo (Analex Corp., Fairview Park, OH.) and John Ferrante Sep. 1991 26 p
(NASA-TP-3155; E-5996; NAS 1.60:3155) Avail: NTIS HC/MF A03 CSCL 11F

Equivalent Crystal Theory (ECT) is a new, semi-empirical approach to calculating the energetics of a solid with defects. The theory has successfully reproduced surface energies in metals and semiconductors. The theory of binary alloys to date, both with first-principles and semi-empirical models, has not been very successful in predicting the energetics of alloys. This procedure is used to predict the heats of formation, cohesive energy, and lattice parameter of binary alloys of Cu, Ni, Al, Ag, Au, Pd, and Pt as functions of composition. The procedure accurately reproduces the heats of formation versus composition curves for a variety of binary alloys. The results are then compared with other approaches such as the embedded atom and lattice parameters of alloys from pure metal properties more accurately than Vegard's law is presented. Author

N91-30319# European Space Agency, Paris (France).
STRUCTURES AND MECHANICAL PROPERTIES OF NEAR-BETA TITANIUM ALLOYS Ti-10V-2Fe-3Al AND Ti-10V-3Cu-3Al Ph.D. Thesis - Paris VI Univ., 1988
Marie Helene Campagnac (Office National d'Etudes et de Recherches Aerospatiales, Paris, France) May 1991 156 p Transl. into ENGLISH of Structures et Proprietes Mecaniques d'Alliage de Titane a bas Transus Ti-10V-2Fe-3Al et Ti-10V-3Cu-3Al (Paris, France, ONERA), 1989 105 p Original language document was announced as N90-26123
(ESA-TT-1200; ONERA-NT-1989-3; ETN-91-99797) Avail: NTIS HC/MF A08

Near beta titanium alloys are becoming increasingly attractive for aircraft structural applications. Ti-10V-2Fe-3Al and Ti-10V-3Cu-3Al belong to this category of material. Both alloys have a similar beta-transus around 800 C. The high temperature beta phase is preserved in Ti-10V-2Fe-Al after quenching to room temperature, whereas Ti-10V-3Cu-3Al undergoes complete transformation. The age hardening reactions were investigated in these two alloys in the 300 to 525 C temperature range using transmission electron microscopy and X-ray analysis. These microstructural investigations show that the morphology and the distribution of the alpha phase can be controlled by varying heat treatments. The effects of double solution treatment, two stage aging treatment on tensile strength, ductibility and fracture toughness are examined and the properties of the two alloys are compared. ESA

N91-30320# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Central Labs.
MAGNETRON SPUTTERING ON 3-DIMENSIONAL SHAPED COMPONENTS: COATING LESS ACCESSIBLE PARTS THROUGH SUBSTRATE MOTION
H. Benien, M. Meyer, and R. Suchentrunk 1990 7 p Presented at Surface Modification Technologies, Paris, France, 6-9 Nov. 1990
(MBB-Z-0308-90-PUB; OTN-030732; ETN-91-99448) Avail: NTIS HC/MF A02

The magnetron sputter deposition on less accessible parts through the substrate motion of three dimensional shaped components is addressed. Drilled holes, inclined surface areas and edges are coated. The coating thickness on the wall (step coverage) for each of these is determined. The step coverage for inclined surfaces is far better, if the substrate rotates during the deposition process. The thickness distribution as a function of the distance from the sputter source is presented. The parts of the substrate which are immersed in the confined plasma are slightly polluted with residual gases. Aluminum coating on steel screws contains 1.6 atom percent oxygen, which is nearly twice that of coatings immersed in the plasma all the time. ESA

N91-30321# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Central Lab.
SUPERPLASTICITY IN USE: A CRITICAL REVIEW OF ITS STATUS, TRENDS, AND LIMITS
Peter-J. Winkler 1990 15 p Presented at MRS Spring Meeting, San Francisco, CA, 16-21 Apr. 1990
(MBB-Z-0309-90-PUB; OTN-030774; ETN-91-99449) Avail: NTIS HC/MF A03

An overview of the practical application of superplasticity in forming operations is presented. Major aerospace materials such as Ti alloys and Al alloys are focused on, and specific characteristics, the material specifications, and supply situation are discussed. Superplastic Forming processing (SPF) is presented including the techniques used for Diffusion Bonding (DB) design concepts, and exemplary SPF and SPF/DB parts are presented. A critical discussion concerning current development trends, and the factors limiting broad application of this manufacturing technique are given. Future prospects are outlined and further research needs emphasized. ESA

N91-30322# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.).
STRUCTURAL BONDING ON ALUMINIUM: INTERFACE MORPHOLOGY AND CHEMISTRY
F. Nitschke 1990 4 p Presented at the 5th Journees d'Etudes sur l'Adherence Metal-Ceramique-Polymeres-Composites, Lyon, France, 18-22 Jun. 1990
(MBB-Z-0321-90-PUB; OTN-030835; ETN-91-99450) Avail: NTIS HC/MF A01

A method to evaluate the borderline morphology for characterization, of the buried interface of structural adhesive bonds is developed. The interface chemistry is studied on a model substrate. The prescence of a strong mechanical interlocking of the adhesive primer with the oxide becomes evident. With the smooth, albeit reactive, model surface, comparatively weak joints are obtained. The interface chemistry is dominated by segregation effects, with little adhesive strongly bound to the oxide surface. ESA

N91-30323# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.).
COPPER DIFFUSION IN PURE ALUMINUM CLADDING: MECHANISM AND INFLUENCE ON CORROSION BEHAVIOR [DIFFUSION VON KUPFER IN REINALUMINIUMPLATTIERSCHICHTEN: MECHANISMUS UND EINFLUSS AUF DAS KORROSIONSVERHALTEN]
U. Koch and H. Dengler 1990 5 p In GERMAN
(MBB-Z-0323-90-PUB; OTN-030837; ETN-91-99451) Avail: NTIS HC/MF A01

Copper diffusion from base material to pure aluminum cladding impairs the protective action for the following reasons. The resting potential and the local corrosion potential are shifted to positive values. Consequently the cathodic protective action of pure aluminum cladding is annihilated. Copper atoms cause a deterioration of the protective properties of the passive oxide film. The corrosion process is accelerated. Local elements corresponding to copper concentration differences are formed on the surface. Copper atom diffusion along the gain boundaries is accelerated. The combination of these two phenomena leads to higher pitting corrodibility. The efficiency of a possible subsequent anodizing is reduced by copper diffusion. Electromechanical measurements are particularly suited for the determination of the corrosion behavior changes caused by copper diffusion. ESA

N91-30324# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.).
EXAMINATIONS OF CORROSION BEHAVIOR FOR ALUMINUM LITHIUM ALLOYS [UNTERSUCHUNGEN ZUM KORROSIONSVERHALTEN VON AL-LI-LEGIERUNGEN]
U. Koch 1990 6 p In GERMAN
(MBB-Z-0324-90-PUB; OTN-030838; ETN-91-99452) Avail: NTIS HC/MF A02

It is shown that the permanent immersion test is suitable for practice relevant simulations. The results of alternating immersion tests are correlatable with outdoor weathering tests. The prevailing corrosion type for AlLi alloys in practice relevant conditions is intercrystalline corrosion, and pitting corrosion with intercrystalline regions. Stress corrosion cracking tests with low strain rate in a neutral NaCl solution are not suitable for determining cracking stress corrosion in AlLi alloys. Pitting corrosion occurs in permanent immersion conditions. As far as 8090C alloys is concerned, stress cracking corrosion is always occurring in connection with intercrystalline corrosion. AlLi alloys must be provided with an additional surface protective coating for use like conventional competitive alloys. AlLi alloys are better protected by anodization against corrosion attack than 2024 comparison alloys. ESA

N91-30325# Technical Research Centre of Finland, Espoo. Metals Lab.
EFFECT OF DEEP SEA ENVIRONMENT ON CORROSION OF SOME ALUMINUM ALLOYS
Pekka Pohjanne Jan. 1991 39 p Sponsored by Finnish Technology Development Center, and Finnish Industry
(VTT-RR-724; ISBN-951-38-3835-8; ISSN-0358-5077; ETN-91-99537) Copyright Avail: NTIS HC/MF A03

Factors which affect the corrosion behavior of materials in the deep sea environment are studied. The corrosion behavior of three aluminum alloys is examined in simulated deep sea conditions. The test results indicate that the pitting corrosion resistance of aluminum alloys decreases as depth increases, but much of the effect depends on the alloys. The deterioration in corrosion resistance is caused by the changes in the chemical composition of the sea water and hydrostatic pressure. ESA

27 NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

For composite materials see *24 Composite Materials.*

N91-30326# Department of Energy, New Orleans, LA. Energy Research Center.
EVALUATING THE PERFORMANCE OF CERAMIC CANDLE FILTERS IN A HOT PARTICULATE-LADEN STREAM
C. M. Zeh, T. K. Chiang, and W. J. Ayers May 1990 59 p
(DE90-000483; DOE/METC-90-4099) Avail: NTIS HC/MF A04

A series of tests was conducted to evaluate the performance of ceramic candle filters at elevated temperatures and pressures using the hot product of a combustion stream, laden with resuspended particulate, from a bench-scale pressurized entrained combustor. Four tests using 1 m length, grade 50/10, silicon carbide candle filters from Industrial Filter and Pump (IF and P) were evaluated at three face velocities with two cleaning techniques. Tests 1, 2, and 3 were operated at nominally 1,550 F, 8.5 atm, with particulate loadings of 775 to 840-ppMw. Test 4 was operated at 1,370 F, 9.9 atm, with a 838-ppMw particulate loading. Gas flow rates for Tests 1, 2, 3, and 4 were nominally 43, 68, 68, and 27 actual cubic feet per minute (acfm), respectively. During steady operating conditions, the specific resistance coefficient (K sub 2) for each of the four tests was within the range of 16 to 22 in. H2O center dot ft center dot min/lb. Candle filter permeability varied with face velocity and cleaning technique used. Permeability decreased with increasing face velocity when temperature and pressure were held constant, and increased with off-line versus on-line cleaning when face velocity was held constant. DOE

N91-30327# Aerospace Corp., El Segundo, CA. Lab. Operations.
THE USE OF SOLID CERAMIC AND CERAMIC HARD-COATED COMPONENTS TO PROLONG THE PERFORMANCE OF PERFLUOROPOLYALKYLETHER LUBRICANTS
D. J. Carre 30 Sep. 1990 26 p
(Contract F04701-88-C-0089)
(AD-A229296; TR-0090(5945-03)-2; SSD-TR-90-32) Avail: NTIS HC/MF A03 CSCL 11/8

The performance of perfluoropolyalkylether (PFPE) oils under boundary lubrication conditions was tested using 440C stainless steel, silicon nitride/440C hybrid, and titanium nitride hard-coated ball-bearing components. By limiting the chemical interactions between the lubricant and iron, the performance was extended by a factor of 5 to 10 using the ceramic materials instead of 440C components. The maximum performance enhancement for the PFPE oils under our test conditions was limited by thermal degradation at the high temperatures generated in the asperity contact region. GRA

N91-30328# North Carolina Univ., Chapel Hill. Dept. of Physics and Astronomy.
MATERIALS PROCESSING OF DIAMOND: ETCHING, DOPING BY ION IMPLANTATION, AND CONTACT FORMATION Annual Report, 1 Oct. 1989 - 30 Sep. 1990
Max L. Swanson 30 Sep. 1990 40 p

(Contract N00014-87-K-0243)
(AD-A229357) Avail: NTIS HC/MF A03 CSCL 20/2

Contact formation, regrowth and implantation doping of natural diamond was studied for future applications to the fabrication of devices from thin film CVD diamond. Thin film diamonds of other ONR contractors were characterized using ion beam methods. The regrowth of ion damaged layers of diamond and the doping of diamond by implantation with Na, Li and F was studied. It was observed that complete regrowth of C ion damage diamond occurred below a critical ion dose. Above that dose, a green phase occurred, which was characterized by a golden green color and by the absence of recovery of the lattice, as measured by ion channeling. Implantation doping studies of Li, Na, and F were initiated, and show some promise for n-type doping of diamond. The diffusivity of Li in diamond was studied by neutron depth profiling. In the important area of regrowth of ion damaged diamond, it was observed that a completely randomized lattice can be regrown when the damaged level is below a certain threshold value, characterized by a deposited energy equivalent to 12 Frenkel defects per cu nm, or about 7 pct. defects. The kinetic mechanisms for regrowth under these conditions, and the influence of impurities such as F and H on the regrowth, are relevant to CVD growth. GRA

N91-30329# Pennsylvania State Univ., University Park. Dept. of Chemistry.
SYNTHESIS OF ALKYL AND ARYL PHOSPHAZENE HIGH POLYMERS Final Report, 1 Jun. 1987 - 30 Sep. 1990
Harry R. Allcock 20 Nov. 1990 8 p
(Contract N00014-84-K-0447)
(AD-A229369) Avail: NTIS HC/MF A02 CSCL 11/10

New elastomers were synthesized that contain a polyphosphazene chain and both alkoxy side groups. In addition, new classes of polyphosphazenes were developed that are high refractive index glasses or have second order nonlinear optical activity. GRA

N91-30330# Massachusetts Inst. of Tech., Cambridge. Dept. of Chemical Engineering.
CONTROL OF MORPHOLOGY OF CRYSTALLIZABLE POLYMER MIXTURES VIA MANIPULATION OF THE HETEROGENEOUS MELT Final Report, 1 May 1987 - 30 Sep. 1990
Robert E. Cohen 9 Nov. 1990 4 p
(Contract N00014-87-K-0517)
(AD-A229395) Avail: NTIS HC/MF A01 CSCL 07/6

Three years of ONR sponsored research in the laboratory has resulted in the discovery of synthetic pathways to produce novel semicrystalline diblock copolymers suitable for emulsifying semicrystalline polymer blends. A model blend system was studied and morphology/mechanical properties relationships were established. Some work on the gas transport behavior of oriented heterogeneous diblocks was conducted. GRA

N91-30331# Materials Research Society, Pittsburg, PA.
PROCESSING SCIENCE OF ADVANCED CERAMICS, VOLUME 155 Final Report, 15 Apr. - 14 Oct. 1989
I. A. Aksay, G. L. McVay, and D. R. Ulrich Sep. 1990 406 p
Proceedings of the Materials Research Society Symposium, San Diego, CA, 27-28 Apr. 1989
(Grant AF-AFOSR-0360-89)
(AD-A229587; AFOSR-90-1057TR) Avail: NTIS HC/MF A18 CSCL 11/2

Advanced ceramics and ceramic matrix composites play an increasingly important role in complex systems for structural, electronic, magnetic, and optical applications. This trend is expected to continue along with a specific goal to tailor composites that display spatial resolution in the micrometer and nanometer range. The fabrication techniques being used range from consolidation of submicron-sized powders to vapor phase deposition. The objective of this symposium was to review the progress made in the field and to identify the remaining critical issues to be solved through innovative processing approaches to improve the properties and reliability of advanced ceramics. In addition, this symposium was intended to complement the series of MRS symposia on Better Ceramics Through Chemistry from a physics and engineering point of view: powder synthesis and colloidal processing; sol-gel processing and ceramic/polymer composites; sol-gel processing of thin films and electronic ceramics; plasma-assisted processing and novel composites; fiber and whisker-reinforced composites. GRA

N91-30332 Department of the Navy, Washington, DC.
METHOD FOR PRODUCING SILVER COATED SUPERCONDUCTING CERAMIC POWDER Patent
William Ferrando, inventor (to Navy) 29 Jan. 1991 9 p Filed 2 Aug. 1989 Supersedes AD-D014300
(AD-D014899; US-Patent-4,988,673; US-Patent-Appl-SN-389220)
Avail: US Patent and Trademark Office CSCL 11/3

A process is disclosed for silver coating superconducting ceramic powder by: (1) coating the superconducting ceramic powder with AgNO3; (2) melting the AgNO3 so that it wets and forms a uniform coating over the surfaces of the particles; and (3) decomposing the AgNO3 to form a thin, uniform coating of the silver metal on the surfaces of the particles. The product is a loose powder of the superconducting ceramic particles which are uniformly coated with silver metal. The powder can be cold worked (e.g., swaged, forged, etc.) to form superconducting structures such as rods or wires. Author

N91-30333*# Old Dominion Univ., Norfolk, VA. Dept. of Civil Engineering.
POLYMER INFILTRATION STUDIES Progress Report, 31 Mar. - 15 Sep. 1991
Joseph M. Marchello Sep. 1991 73 p
(Grant NAG1-1067)
(NASA-CR-188708; NAS 1.26:188708) Avail: NTIS HC/MF A04 CSCL 11C

Progress was made on the preparation of carbon fiber composites using advanced polymer resins. Processes reported include powder towpreg process, weaving towpreg made from dry powder prepreg, composite from powder coated towpreg, and toughening of polyimide resin (PMR) composites by semi-interpenetrating networks. Several important areas of polymer infiltration into fiber bundles will be researched. Preparation to towpreg for textile preform weaving and braiding and for automated tow placement is a major goal, as are the continued development of prepregging technology and the various aspects of composite part fabrication. Author

N91-30334 Pennsylvania State Univ., University Park.
FAST FRACTURE AND LIFETIME PREDICTION OF CERAMIC TUBULAR COMPONENTS Ph.D. Thesis
Osama M. Jadaan 1990 239 p
Avail: Univ. Microfilms Order No. DA9117697

Experimental and analytical methodologies were developed to predict the fast fracture and delayed failure behavior of ceramic materials in tubular forms. The objectives were to develop: (1) improved test and analytical methodologies from which to predict the strength distribution of internally pressurized SiC tubes from the strength distributions of simple laboratory specimens; and (2) experimental and analytical methodologies to predict the life time of internally pressurized SiC tubes from the life time reliability analysis of simple specimens subjected to similar delayed failure modes. The methodology for predicting the strength distribution of ceramic tubes was based on Weibull statistics which accounted for differences in stress distributions and volume or area of material stressed in tension. It was shown that this technique successfully predicted the strength distribution of long tubes from the strength distributions of O-ring and C-ring specimens. This result was shown to be true for the SCRB210 material up to 1200 C and for the SASC material up to 1300 C. Finite element analysis was used to determine the strain rate distribution in a thick-wall tube subjected to sustained internal pressure. This analysis was used along with the Monkman-Grant creep rupture criterion to predict the lifetime of SCRB210 tubes. Results showed a large difference between

experimental and predicted life times. This difference was due to the existence of huge defects in the SCRB210 tubes which failed at low stresses. These tubes failed in crack growth mode rather than creep mode. Dynamic fatigue testing of SASC O-ring and compressed C-ring specimens was used to obtain the SCG parameters which are essential for lifetime prediction of SASC tubes. The effect of threshold stress intensity factor was incorporated in this analysis. Two methods were used to predict the lifetimes of SASC tubes. The first was a fracture mechanics approach known in the literature. The second approach utilized a procedure in which the lifetime of any specimen can be estimated from another. Dissert. Abstr.

N91-30335 Defence Research Establishment Atlantic, Dartmouth (Nova Scotia).
THE EFFECT OF ANTIMONY TRIOXIDE ADDITION ON THE FLAMMABILITY CHARACTERISTICS OF POLYESTER AND VINYL ESTER GLASS REINFORCED PLASTICS
Richard M. Morchat May 1989 29 p
(DREA-89-213; CTN-91-60192) Avail: NTIS HC A03

The effects of an inorganic fire-retardant additive, antimony trioxide, on flammability characteristics and smoke generation of glass reinforced polyester and vinyl ester plastics were evaluated. Information is presented on the flame spread index (ASTM E162), limiting oxygen index (ASTM D2863), density of smoke generated (ASTM E662) and toxic gases of combustion (Boeing BSS 7239). Addition of the fire-retardant additive to the glass reinforced plastic materials significantly decreased the flame spread index and increased the limiting oxygen index; however, the amount of smoke generated during pyrolytic and flaming combustion was high and unacceptable. Finally, the toxic gas evolution data indicated that the threshold limit values for some gases were exceeded.
Author (CISTI)

N91-30336 Ontario Research Foundation, Mississauga.
EVALUATION OF FLAMMABILITY PROPERTIES OF GLASS-REINFORCED PLASTICS FOR MARINE USE
H. J. Campbell and E. W. Simmons 17 Mar. 1988 32 p
(Contract DREA-W7707-7-7895-01-OSC)
(DREA-CR-88-411; CTN-91-60205) Avail: NTIS HC A03

A series of twenty-five glass-reinforced plastic (GRP) laminates comprising of polyester, vinyl ester and phenolic resin systems in either the unmodified condition (no time retardant additive) or compounded with one of four different fire retardant additives (5 percent antimony trioxide, 5 percent Nyacol (colloidal antimony trioxide), 25 percent aluminum trihydrate and 10 percent zinc borate) were evaluated in terms of oxygen index (ASTM D2863), flame spread index (ASTME 162), smoke generation (ASTM E62) and toxic gas generation (Boeing BSS 239). The results demonstrate that the phenolic resin is by far the best of the entire group: high oxygen index, very low flame spread index, low smoke generation, relatively low carbon monoxide generation and generally small to negligible amounts of acid gases. The other resin systems, including those modified with fire retardants, offer much less favorable indices. A major problem is the extremely high smoke generation levels shown by these non char-forming resin systems. For the fire retardant modified Derakane and Hetron polyester resins, the additives generally raised the oxygen indices and lowered the flame spread indices. The effect on smoke and carbon monoxide generation was variable. Because the phenolic GRP laminate clearly affords superior flammability related parameters, it is recommended that future activity should focus on resins of the phenolic type. Author (CISTI)

N91-30337 Research and Productivity Council (New Brunswick).
FRACTOGRAPHY APPLIED TO POLYMERIC MATERIALS, PART 5
A. B. Mitchell, J. C. Thornley, and P. Chan 1 Sep. 1988 129 p
(Contract DREA-W7707-7-7850-01-OSC)
(DREA-CR-88-441-Pt-5; CTN-91-60206) Avail: NTIS HC A07

A detailed study of the structures of polyacetal (Delrin TM) and polyvinyl chloride (PVC) (Boltaron) revealed by thermal and chemical etching techniques is described. The results of a study of the effect of sample thickness on the time to failure in creep and environmental stress cracking tests are also included. Samples of PVC, 3.17 mm, 6.35 mm, and 9.53 mm thick, were tested and a thickness effect was observed for the samples which failed in the environmental stress cracking mode. An acoustic microscopy study of material structure gave inconclusive results and indicates that refinement of the technique is necessary before it can be used to study plastic structure. Author (CISTI)

N91-30338# Institut National des Sciences Appliquees, Lyon (France). Groupe d'Etudes de Metallurgie Physique et de Physique des Materiaux.
INFLUENCE OF MICROSTRUCTURE ON FRACTURE BEHAVIOR AND THERMAL SHOCK RESISTANCE FOR CARBON MATERIALS Ph.D. Thesis [INFLUENCE DE LA MICROSTRUCTURE SUR LE COMPORTEMENT A LA RUPTURE ET LA RESISTANCE AU CHOC THERMIQUE DES MATERIAUX CARBONES]
Benedicte Arnould-Allard 1990 197 p In FRENCH
(ISAL-90-0097; ETN-91-99473) Avail: NTIS HC/MF A09

The damage mechanisms under mechanical and thermal stresses were studied for carbon materials. The microstructure effect on crack propagation resistance was investigated. Acoustic emission allowed the influence of various phases of microstructure to be determined with regard to grain type and anthracite rate. Cracking path and fracture faces were observed, using a microscope. Schematic characteristics of carbon material microstructure with a low and strong crack propagation resistance were outlined. A test based on a laser beam directed to disk center was developed in order to classify the materials with regard to thermal shock resistance. As no damage due to thermal shock was recorded the method did not prove adequate. A comparison of materials carried out with the various theoretical thermal shock resistance criteria showed that a good resistance to thermal shock damage is advisable. ESA

N91-30339# National Aerospace Lab., Amsterdam (Netherlands). Structures and Materials Div.
THERMAL SHOCK AND OXIDATION RESISTANCE OF CERAMIC COATINGS
J. A. M. Boogers, R. J. H. Wanhill, and H. J. C. Hersbach 1 Mar. 1989 20 p Presented at AGARD Specialists Meeting on High Temperature Surface Interactions, Ottawa, Ontario, Apr. 1989 Previously announced as N90-28711 Sponsored by Royal Netherlands Air Force
(NLR-TP-89085-U; ETN-91-99642) Avail: NTIS HC/MF A03

Thermal shock and long term oxidation tests on ceramic thermal barrier coatings were done under flight simulation conditions in a burner rig. Three coatings combinations were investigated: magnesium stabilized zirconia topcoat with Ni-5 Al bondcoat; magnesium stabilized zirconia topcoat with NiCoCrAlY bondcoat; yttrium stabilized zirconia topcoat with NiCoCrAlY bondcoat. The ZrO2/Y2O3 + NiCoCrAlY combination showed superior resistance to thermal shock and long termal oxidation as compared to the ZrO2/MgO + Ni-5 coating. The long term oxidation resistance of the ZrO2/MgO + NiCoCrAlY combination was intermediate to that of the other two coatings. Degradation of the coatings was examined in detail, and the practical significance of the results is assessed. ESA

N91-30340# Oak Ridge National Lab., TN.
TENSILE CREEP BEHAVIOR AND CYCLIC FATIGUE/CREEP INTERACTION OF HOT-ISOSTATICALLY PRESSED SI3N4
K. C. Liu, H. Pih, C. O. Stevens, and C. R. Brinkman 1991 17 p Presented at the Automotive Technology Development Contractors' Coordination Meeting, Dearborn, MI, 22-25 Oct. 1991
(Contract DE-AC05-84OR-21400)
(DE91-007182; CONF-911050-1) Avail: NTIS HC/MF A03

Tensile creep data are reported for a high-performance grade of hot isostatically pressed Si3N4 that is currently being investigated as a candidate material for advanced heat engine applications. Specimens were tested in pure uniaxial tension at temperatures ranging from 1200 to 1370 C. Creep strain was measured with an

optical strain extensometer until creep rupture occurred, in some cases for periods in excess of 2000 h. To study the effects of various preloading material histories on creep behavior, specimens were prepared and tested in several conditions, i.e., unannealed, annealed, or precycled. Test results show that either treatment by thermal annealing or by precycling at 1370 C can dramatically modify the initial transient creep behavior and enhance the resistance to creep deformation and hence the creep-rupture lifetime. However, the influence of the preloading histories on creep rate was diminished by high temperature exposure after about 500 h of testing. The rupture lifetime of the precycled specimen at 1370 C was significantly higher than those of the unannealed and annealed specimens. In contrast, no significant extension of the creep-rupture lifetime was observed for a precycled specimen tested at 1300 C. Steady-state creep was absent in some cases under certain conditions of temperature, stress, and heat treatment. Little or no tertiary creep was usually detected before specimen fracture occurred. The steady-state creep rate of this material was found to be a function of applied stress, temperature, and possibly the level of crystallinity in the intergranular phase. DOE

N91-30341# Aeronautical Research Labs., Melbourne (Australia).
ION VAPOUR DEPOSITED (IVD) ALUMINUM COATINGS FOR THE CORROSION PROTECTION OF HIGH STRENGTH STEEL
B. R. W. Hinton and W. J. Pollock Apr. 1991 52 p
(ARL-MAT-R-123; AR-006-584) Copyright Avail: NTIS HC/MF A04

Extensive matallographic, corrosion, and hydrogen embrittlement tests were carried out with high strength steel sheet coated with ion vapor deposited (IVD) aluminum. Metallography showed that the thickness of the as-deposited IVD coatings was not uniform and that the coatings contained extensive microporosity. The application of glass bead blasting after coating significantly reduced the porosity but did not remove it completely. The IVD coatings were found to be effective in preventing corrosion of the steel substrate provided the coating was sufficiently thick and its porosity low. Exposure of IVD coated steel to aqueous environments was found to produce hydrogen embrittlement of the high strength steel substrate under certain conditions. Author

28 PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers; their storage and handling procedures; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

N91-30342 Department of the Navy, Washington, DC.
AERIAL FLARE AND IGNITER Patent
Stanley J. Herold, inventor (to Navy), Charles D. Howard, inventor (to Navy), and Donald E. LaGrange, inventor (to Navy) 2 Apr. 1991 9 p Filed 7 Aug. 90
(AD-D014940; US-Patent-5,003,881; US-Patent-Appl-SN-564234) Avail: US Patent and Trademark Office CSCL 19/1

An illuminating flare is presented which has an igniter in which a two-part inertial mass is guided for relative aftward movement from a safe position to an armed position under launching forces. One part of the mass undergoes relative forward movement to an ignition position under parachute-opening, deceleration forces while the other part of the mass is restrained from moving as far forward as the first part. This separation of the parts of the mass releases locking balls to unlock a firing pin, which stabs a primer and initiates ignition of the flare. The primer is contained in a rotor, and as the mass traverses from the safe position to the armed position it rotates and the rotor rotates with the mass. In the safe position the primer is out of communication with an ignition passage through which ignition of the illuminant composition occurs. Rotation of the rotor as the mass traverses to the armed position places the primer in communication with the ignition passage where it remains until activated by the firing pin. GRA

N91-30343*# Alabama Univ., Huntsville. Dept. of Mechanical Engineering.
COMPOSITE PROPELLANT TECHNOLOGY RESEARCH: MECHANICAL PROPERTY CHARACTERIZATION Semiannual Progress Report, period ending 12 Sep. 1991
Mark V. Bower 12 Sep. 1991 31 p
(Grant NAG8-850)
(NASA-CR-187824; NAS 1.26:187824) Avail: NTIS HC/MF A03 CSCL 21I

Proof for the existence of a single Poisson's ratio function in isotropic linear viscoelastic materials is presented. An in-depth discussion is given of three dimensional viscoelastic material properties and their relationships to linear isotropic and orthotropic viscoelastic materials. A discussion of the alternate invariant definition as used by Abaqus and how it relates to the form used by Dr. S. Peng is presented. Author

29 MATERIALS PROCESSING

Includes space-based development of products and processes for commercial applications.

For biological materials see *55 Space Biology.*

N91-30344*# Aeritalia S.p.A., Naples (Italy). Space Systems Group.
TETHERED GRAVITY LABORATORIES STUDY Final Report
F. Lucchetti Nov. 1989 149 p
(Contract NAS9-17877)
(NASA-CR-185656; NAS 1.26:185656) Avail: NTIS HC/MF A07 CSCL 22A

The use is studied of tether systems to improve the lowest possible steady gravity level on the Space Station. Particular emphasis is placed by the microgravity community on the achievement of high quality microgravity conditions. The tether capability is explored for active control of the center of gravity and the analysis of possible tethered configurations. Author

N91-30345*# Michigan Univ., Ann Arbor. Dept. of Mechanical Engineering and Applied Physics.
A FUNDAMENTAL STUDY OF NUCLEATE POOL BOILING UNDER MICROGRAVITY Final Report
Jamie S. Ervin and Herman Merte, Jr. Aug. 1991 300 p
(Grant NAG3-663)
(NASA-CR-188732; NAS 1.26:188732; UM-MEAM-91-08) Avail: NTIS HC/MF A13 CSCL 20D

An experimental study of incipient boiling in short-term microgravity and with a/g = +/- 1 for pool boiling was performed. Calibrated thin gold films sputtered on a smoothly polished quartz surface were used simultaneously for thermal resistance measurements and heating of the boiling surface. The gold films were used for both transient and quasi-steady heating surface temperature measurements. Two test vessels were constructed for precise measurement and control of fluid temperature and pressure: a laboratory pool boiling vessel for the a/g = +/- experiments and a pool boiling vessel designed for the 131 m free-fall in the NASA Lewis Research Center Microgravity Research Facility for the microgravity tests. Measurements included the heater surface temperature, the pressure near the heating surface, and the bulk liquid temperatures. High speed photography was used in the experiments. With high quality microgravity and the measured initial temperature of the quiescent test fluid, R113, the temperature distribution in the liquid at the moment of boiling inception resulting from an imposed step in heat flux is known with a certainty not possible previously. The types of boiling propagation across the large flat heating surface are categorized; the conditions necessary for their occurrence are described. Explosive boiling propagation with a striking pattern of small scale protuberances over the entire vapor mass periphery not observed previously at low heat flux levels is described. For the heater

surface with a/g = -1, a step in the heater surface temperature of short duration was imposed. The resulting liquid temperature distribution at the moment of boiling inception was different from that obtained with a step in heat flux. Author

N91-30346*# Aeritalia S.p.A., Turin (Italy). Space Systems Group.
TETHERED GRAVITY LABORATORIES STUDY Mid-Term Review, 26-28 Sep. 1989
F. Lucchetti 1989 252 p
(Contract NAS9-17877)
(NASA-CR-185660; NAS 1.26:185660) Avail: NTIS HC/MF A12 CSCL 22A

Information on the Tethered Gravity Laboratory on the International Space Station is given in viewgraph form. Topics covered include active control, low gravity processes identification, systems analysis, tether interfaces with the Laboratory, elevator and payload configurations, elevator subsystems, and accelerometer technology requirements. Author

N91-30347*# Aeritalia S.p.A., Naples (Italy). Space Systems Group.
TETHERED GRAVITY LABORATORIES STUDY Quarterly Progress Report No. 7, 25 Aug. - 24 Nov. 1989
F. Lucchetti Dec. 1989 83 p
(Contract NAS9-17877)
(NASA-CR-185659; NAS 1.26:185659) Avail: NTIS HC/MF A05 CSCL 22A

Tethered gravity laboratories study is presented. The following subject areas are covered: variable gravity laboratory; attitude tether stabilizer; configuration analysis (AIT); dynamic analysis (SAO); and work planned for the next reporting period. Author

N91-30348*# Aeritalia S.p.A., Naples (Italy). Space Systems Group.
TETHERED GRAVITY LABORATORIES STUDY Quarterly Progress Report No. 5, 25 Feb. - 24 May 1989
F. Lucchetti Jun. 1989 83 p
(Contract NAS9-17877)
(NASA-CR-185657; NAS 1.26:185657) Avail: NTIS HC/MF A05 CSCL 22A

Variable Gravity Laboratory studies are discussed. The following subject areas are covered: (1) conceptual design and engineering analysis; (2) control strategies (fast crawling maneuvers, main perturbations and their effect upon the acceleration level); and (3) technology requirements. Author

N91-30349*# Aeritalia S.p.A., Naples (Italy). Space Systems Group.
TETHERED GRAVITY LABORATORIES STUDY Quarterly Progress Report No. 6, 25 May - 24 Aug. 1989
F. Lucchetti Sep. 1989 88 p
(Contract NAS9-17877)
(NASA-CR-185658; NAS 1.26:185658) Avail: NTIS HC/MF A05 CSCL 22A

The following subject areas are covered: (1) thermal control issues; (2) attitude control sybsystem; (3) configuration constraints; (4) payload; (5) acceleration requirements on Variable Gravity Laboratory (VGL); and (6) VGL configuration highlights. Author

N91-30350*# Alabama Univ., Huntsville. Center for Microgravity and Materials Research.
RESIDUAL ACCELERATION DATA ON IML-1: DEVELOPMENT OF A DATA REDUCTION AND DISSEMINATION PLAN Semiannual Progress Report No. 5, 1 Mar. - 31 Aug. 1991
Melissa J. B. Rogers, J. Iwan D. Alexander, and Randy Wolf 1991 48 p
(Grant NAG8-759)
(NASA-CR-188760; NAS 1.26:188760) Avail: NTIS HC/MF A03 CSCL 22A

A residual acceleration data analysis plan is developed that will allow principal investigators of low-gravity experiments to efficiently process their experimental results in conjunction with accelerometer data. The basic approach consisted of the following program of research: (1) identification of sensitive experiments and sensitivity ranges by order of magnitude estimates, numerical modelling, and investigator input; (2) research and development towards reduction, supplementation, and dissemination of residual acceleration data; and (3) implementation of the plan on existing acceleration data bases. Author

N91-30351*# Michigan Univ., Ann Arbor. Dept. of Mechanical Engineering and Applied Mechanics.
A STUDY OF FORCED CONVECTION BOILING UNDER REDUCED GRAVITY Final Report, 2 Jan. 1985 - 31 Dec. 1990
Herman Merte, Jr. Sep. 1991 196 p
(Grant NAG3-589)
(NASA-CR-186266; NAS 1.26:186266; UM-MEAM-91-12) Avail: NTIS HC/MF A09 CSCL 22A

The results are presented of a study of forced convection boiling under reduced gravity. An attempt was made to improve the understanding of the basic processes that constitute forced convection boiling by removing the buoyancy effects which may mask other phenomena. The effects, if any, are sought which are apparent with the removal of body forces to the lowest possible levels have on the forced convection boiling heat transfer processes in well defined and meaningful circumstances. If such effects are present, then the boundaries are sought of the relevant parameters such as heat flux, heater surface superheat, fluid velocity, bulk subcooling, and geometric/orientation relationships within which such effects are produced. A flow loop was designed and made to permit operation at low velocities and various orientations in the test section. Results are presented for both transient and quasi-steady nucleate boiling. Author

31 ENGINEERING (GENERAL)

Includes vacuum technology; control engineering; display engineering; cryogenics; and fire prevention.

N91-30352# CIM Systems, Lynchburg, VA. Mfr. and Systems Technology Div.
IN-PROCESS INSPECTION STUDY (IPIS) FOR ABRASIVE MACHINING (HONING) Final Report, Jun. 1989 - Sep. 1990
Michael A. Paul, V. E. Stubbs, Michael W. Minnick, and Donald G. Eitzen 9 Nov. 1990 271 p
(Contract DAAA08-89-C-0084)
(AD-A236244; SE-91-03) Avail: NTIS HC/MF A12 CSCL 13/8

This study was to prove the feasibility of in-process inspection of parts being honed on the inside diameter. Capacitance and inductive (eddy current) sensors were bench tested for accuracy and for the sensitivities of these measurements to honing oil. Unlike capacitance sensing, eddy current sensing was insensitive to the oil, so a honing machine was set up that has two eddy current sensors diagonally opposed to each other in a fixture screwed to the honing head. The wires were fed through flexible coupling to a slip ring, where the signals were routed through a signal conditioner to a 12 bit analog voltage to digital conversion (data acquisition) board in a computer. A lookup table was automatically used to correct for deviations from linearity of the sensors. A color monitor enabled graphical displays of individual readings in real time. The data acquisition board introduced a plus or minus 0.0005 inch error from an 11 degree rotation between the readings of the two opposed sensors. Using truly differential gaging and sensors that match the full voltage range of the data acquisition board, more accurate roundness determinations could be made. Bench tests showed potentials of fiber optic and ultrasonic sensors to automatically measure surface finish of a wiped or coolant coupled part, respectively, on a honing machine and to detect large changes in surface finish in real time, as when a breaking stone would cause a flaw. GRA

N91-30353# Argonne National Lab., IL.
DESIGN AND FABRICATION ISSUES FOR SMALL-SCALE SMES

J. R. Hull, S. M. Schoenung, D. N. Palmer, and M. K. Davis (ABB, Inc., Windsor, CT.) 1991 11 p Presented at the Cryogenic Engineering Conference and International Cryogenic Materials Conference, Huntsville, 11-14 Jun. 1991
(Contract W-31-109-eng-38)
(DE91-014008; ANL/CP-73359; CONF-910635-1) Avail: NTIS HC/MF A03

Coil-scaling and structural-force calculations for small-scale solenoidal and toroidal superconducting magnetic energy storage (SMES) systems are presented. The efficiency of the refrigeration system is estimated as a function of mechanical support, insulation, and power-lead thermal losses. Required high-temperature superconductor (HTS) properties are compared to properties of presently available materials or those expected to evolve in the near term. Potential applications are described for small-scale SMES, and these applications will significantly increase when HTS's can be used. DOE

N91-30354# Air Force Systems Command, Wright-Patterson AFB, OH. Foreign Technology Div.
NEW TECHNIQUE OF MACHINING HIGH PRECISION MIRROR SURFACE PRESS ROLLER
Deng Hongsen 27 Mar. 1991 9 p Transl. into ENGLISH from Jichuang (Peoples Rep. of China) v. 10, no. 148, 1988 p 35-36
(AD-A237195; FTD-ID(RS)T-1104-90) Avail: NTIS HC/MF A02 CSCL 20/6

High precision mirror surface press roller machining technique of corrosion and grinding proof is one of the key techniques that the production enterprises as well as the machining and manufacturing of the following industries sought to resolve for a long time: plastics, papermaking, rubber, film, and chip production. In Oct. 1984, a new comprehensive machining technique of metal brush coating, grinding with abrasive belt, as well as buffing was used to conduct nearly 20 experiments. In Jan. 1985, a pair of middle convex high precision mirror surface press rollers was successfully machined. The technical process is described. Author

32 COMMUNICATIONS AND RADAR

Includes radar; land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Space Communications, Spacecraft Communications, Command and Tracking.* For search and rescue see *03 Air Transportation and Safety,* and *16 Space Transportation.*

N91-30355# Naval Research Lab., Washington, DC.
AN INTRODUCTION TO IMPULSE RADAR Memorandum Report
Merrill I. Skolnik 20 Nov. 1990 50 p
(AD-A229381; NRL-MR-6755) Avail: NTIS HC/MF A03 CSCL 17/9

An impulse radar is one whose waveform is a single cycle sinewave. Its most distinctive characteristic is its very wide relative bandwidth. Much has been said and claimed for such a radar, as compared to conventional narrowband radar; but there is very little written about what it is, what it can and cannot do, and what is required to achieve such radars in practice. A description is presented of the spectrum of an impulse radar as compared to the more usual short pulse radar. The requirements, problems, and current technology of the various subsystem that make up an impulse radar (transmitters, receivers, and antennas) are discussed. All three of these major subsystems for an impulse radar are presently far from adequate for practical applications (other than for probing underground). A number of problem areas are reviewed, including electromagnetic compatibility, target scattering, the radar is discussed and the differences noted. Several potential applications are briefly reviewed, including target-to-clutter enhancement, target recognition, resolution of low altitude multipath, and target scattering enhancement, as well as its successful use for underground probing. Currently, the claims made for many of the proposed applications were justified, but the major differences between the impulse radar and conventional radar provide interesting technical challenges that would be worthy of fundamental investigation and understanding. GRA

N91-30356# Ohio State Univ., Columbus. Electroscience Lab.
BISPECTRAL ANALYSIS OF RADAR SIGNALS WITH APPLICATION TO TARGET CLASSIFICATION
I. Jouny, E. K. Walton, R. L. Moses, and F. D. Garber Aug. 1990 191 p
(Contract N00014-90-J-1200)
(AD-A229388; ESL-723090-2) Avail: NTIS HC/MF A09 CSCL 17/9

The bispectral processing is studied of complex valued radar target scattering signatures and the impact of such processing on target identification. The concept of birange profile as 2-D display of target scattering mechanisms in the range domain is introduced. It is shown that the birange profile can detect responses due to multiple scattering interactions. An algorithm is proposed to estimate the birange profiles of radar targets. Using this algorithm, multiple interactions of real aircraft are extracted, and interpreted in terms of target geometry. An algorithm that uses autoregressive parametric modeling of radar signatures to obtain high resolution birange profiles was introduced and tested using synthesized data and real scattering data. An alternative estimation procedure, which does produce the true bispectrum, was developed. The classification aspect of birange features was investigated using cross correlation of birange profile of unknown target with that of a catalog target. It was shown that classification using birange features is inferior to classification using impulse response features if the additive noise is Gaussian. Classification with the birange when the noise is non-Gaussian yields relatively reasonable results in comparison with other classifiers. Finally, it was shown that when scattering from extraneous point scatterers is added to the data, then classification with the birange outperforms other classifiers if the signal to extraneous scatters ratio is low. GRA

N91-30357# Ballistic Research Labs., Aberdeen Proving Ground, MD.
AN ALTERNATIVE FORM OF THE MODIFIED POINT-MASS EQUATION OF MOTION Final Report, Jun. - Aug. 1990
James W. Bradley Nov. 1990 16 p
(DA Proj. 1L1-62618-AH-80)
(AD-A229514; BRL-MR-3875) Avail: NTIS HC/MF A03 CSCL 17/9

The point-mass equation of motion is usually given in the form of an explicit expression for the acceleration U.dot (vector). The modified point-mass equation is obtained by adding yaw-of-repose terms to the right-hand side. These new terms are functions of U.dot (vector) so that U.dot (vector) now occurs on both sides of the equation. In this report, the modified point-mass equation is rewritten in the form of an explicit expression for the acceleration. GRA

N91-30358# Naval Research Lab., Washington, DC.
PHASE-CODED WAVEFORMS AND RANGE SUPERRESOLUTION Interim Report, Oct. 1989 - Oct. 1990
W. F. Gabriel 5 Nov. 1990 23 p
(AD-A229530; NRL-MR-6738) Avail: NTIS HC/MF A03 CSCL 17/9

Phase-coded pulse-compression waveforms have been investigated for compatibility with superresolution processing techniques in the range domain. Two waveforms were tested via simulated data; a binary Barker code, and a quadriphase code. The binary code was not compatible and did not permit resolution finer than the conventional matched filter. The quadriphase code, on the other hand, was found to be partially compatible and permitted accurate resolution/location of one or two point targets within a rangebin. However, it could not handle more than two closely spaced targets because of its inherent limitation of two degrees-of-freedom (for superresolution processing purposes). Therefore, these phase-coded waveforms are not recommended

for high resolution processing in range. The processor burden would not be cost effective for the limited benefits available.
GRA

N91-30359*# National Aeronautics and Space Administration, Washington, DC.
POLAR COMMUNICATIONS: STATUS AND RECOMMENDATIONS. REPORT OF THE SCIENCE WORKING GROUP
T. J. Rosenberg, ed. (Maryland Univ., College Park.) and K. C. Jezek, ed. Dec. 1987 37 p
(NASA-TM-105035; NAS 1.15:105035) Avail: NTIS HC/MF A03 CSCL 17B

The capabilities of the existing communication links within the polar regions, as well as between the polar regions and the continental United States, are summarized. These capabilities are placed in the context of the principal scientific disciplines that are active in polar research, and in the context of how scientists both utilize and are limited by present technologies. Based on an assessment of the scientific objectives potentially achievable with improved communication capabilities, a list of requirements on and recommendations for communication capabilities necessary to support polar science over the next ten years is given. Author

N91-30360# Advanced CounterMeasure Systems, Sacramento, CA.
USE OF PROPERTY RESTORAL ALGORITHMS FOR BLIND ADAPTATION OF RECEIVE-PATH AND TRANSMIT-PATH ANTENNA ARRAYS IN A GROUND-BASED COMMUNICATION SYSTEM, PHASE 1 Final Report, Sep. 1990 - Feb. 1991
Dean W. Minster 22 Feb. 1991 132 p
(Contract DAAL03-90-C-0025)
(AD-A234242; ARO-27981.1-EL-SBI) Avail: NTIS HC/MF A07 CSCL 25/5

A receive adaptation algorithm which is tailored for spread spectrum communications, frequency hopping and direct sequence, has been developed. A receive architecture which is compatible with existing Army radios, yet flexible enough to accommodate a variety of algorithms, using commercially available and proven components, and with minimum complexity to allow size and power reductions in future designs to result in compatibility with the Army's mobile applications, has been developed. The performance of the algorithm and limitations of the architecture have been simulated, and the expected performance is evaluated. In addition, the possibility of using the information acquired during receive adaptation to steer transmit beams in either retrodirective or directive fashion was explored. Two applications in particular are addressed: Low Probability of Intercept (LPI) and Anti-Jam (A/J) communications. The concepts for application of an Adaptive Array Processor (AAP) to LPI and A/J communications is presented, and the expected performance is simulated and evaluated. GRA

N91-30361# Los Alamos National Lab., NM.
HIGH PERFORMANCE COMPUTING AND COMMUNICATIONS: INVESTMENT IN AMERICAN COMPETITIVENESS
15 Mar. 1991 296 p Prepared in cooperation with Gartner Group, Inc., Stamford, CT
(Contract W-7405-eng-36)
(DE91-010975; LA-SUB-91-1) Avail: NTIS HC/MF A13

This report presents the results of a study performed by Gartner Group, Inc. for the U.S. Department of Energy (DOE), through a contract with the Los Alamos National Laboratory (LANL). The purpose of the study is to estimate the economic impact of the Federal High Performance Computing and Communications (HPCC) Program which was proposed by the Office of Science and Technology Policy (OSTP), Executive Office of the President, on September 8, 1989. That Program is an implementation of the Research and Development Strategy for High Performance Computing, which was transmitted to Congress by OSTP on November 20, 1988. The objective of this Gartner Group study to provide an assessment of the likely economic impact and benefits of the Federal HPCC Program and the risks of non-support of this program. The goals of the HPCC Program are to: support computational advances through R and D effort; Reduce uncertainties to industry through increased cooperation and continued use of government as a market for High Performance Computing (HPC) prototypes; Support underlying research, network, and computational infrastructures; and support the U.S. human resource base. DOE

N91-30362# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Electromagnetic Wave Propagation Panel.
USE OR REDUCTION OF PROPAGATION AND NOISE EFFECTS IN DISTRIBUTED MILITARY SYSTEMS
C. Goutelard 1990 293 p In ENGLISH and FRENCH Symposium held in Rethymno, Greece, 15-18 Oct. 1990
(AGARD-CP-486; ISBN-92-835-0601-4) Copyright Avail: NTIS HC/MF A13; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The papers presented to symposium held by the Electromagnetic Wave Propagation Panel at its Fall 1990 meeting are compiled. The topics covered on the occasion of that symposium are: (1) effects on distributed systems of the space, the time, and the frequency coherence of waves; (2) jamming and noise reduction effects on distributed systems; and (3) distributed systems (radio communications, radar systems, satellites, and ECM and ECCM in the systems). For individual titles, see N91-30363 through N91-30383.

N91-30363# Boston Univ., MA. Center for Space Physics.
THE DYNAMICS OF F-LAYER IRREGULARITIES RELATIVE TO SPACE, TIME, AND FREQUENCY DIVERSITY
Jules Aarons *In* AGARD, Use or Reduction of Propagation and Noise Effects in Distributed Military Systems 1990 13 p Sponsored by ONR (For primary document see N91-30362 22-32)
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With the statistics of morphology of F-layer irregularities now in hand, it is possible to forecast in broad terms what to expect at equatorial, auroral, and polar latitudes during various levels of solar flux. With the beginning of an understanding of the effect of the various phases of magnetic storms on generating irregularities as noted from the solar wind, ring current, convection, auroral index, and magnetic index parameters, it is possible to roughly forecast levels of F-layer irregularity intensity. With these in hand, the utility of space, time, and frequency diversity can be evaluated. Diversity could be used if forecasting in real time was possible. The dynamics of irregularity generation and inhibition during various phases of ring current and magnetic activity is outlined. Author

N91-30364# Naval Ocean Systems Center, San Diego, CA. Ocean and Atmospheric Sciences Div.
OPTIMUM SPACE, TIME, AND FREQUENCY SAMPLING OF THE IONOSPHERE WITH ADVANCED DIGITAL IONOSONDES **c46**
Adolf K. Paul and David B. Sailors *In* AGARD, Use or Reduction of Propagation and Noise Effects in Distributed Military Systems 1990 8 p (For primary document see N91-30362 22-32)
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Ionosondes were always an important tool for the observation of the ionosphere. The traditional analog instruments were only capable of measuring the travel time or virtual height as a function of frequency with limited accuracy. Advanced digital radiosondes are now capable of recording additional information, such as the radio phase and the amplitude of each echo. If the echoes are recorded at several receiving antennas, the change of phase with antenna location permits a highly accurate estimate of the angle of arrival or the apparent location of the reflection point. Repeating the transmission of a given frequency a short time later yields the Doppler frequency as a function of the radio frequency. Author

N91-30365# Johns Hopkins Univ., Laurel, MD. Applied Physics Lab.

THE UTILITY OF HIGH FREQUENCY GROUND WAVE IN A DISTRIBUTED COMMUNICATION SYSTEM

James R. Champion *In* AGARD, Use or Reduction of Propagation and Noise Effects in Distributed Military Systems 1990 6 p (For primary document see N91-30362 22-32)

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High frequency ground wave (HFGW) communication in mountain terrain is investigated. Using a broadband, discone antenna and 100 watts of power, communication links in the 20 to 30 MHz band of at least 50 and, in some cases, as much as 115 km were established over mountainous paths. Links were non-line-of-sight, and immune to ionosopheric fading. Digital and wide-band frequency hopping communications were demonstrated using HFGW. The discone antenna is about 3.5 m high when assembled and can be made extremely portable. The spacial characteristics of the 20 to 50 MHz band coupled with the properties of the discone antenna would offer advantages to distributed communication systems in mountainous terrain. HFGW results are presented and it is discussed how this medium may be exploited in a distributed system which uses both frequency and spatial distribution. Author

N91-30366# Physics and Electronics Lab. TNO, The Hague (Netherlands).

RESULTS OF MEASUREMENTS PERFORMED ON HF BACKSCATTER FOR EVALUATING THE INFLUENCE ON SHORT RANGE HF DATA LINKS

P. J. vanVliet and P. A. vanderVis *In* AGARD, Use or Reduction of Propagation and Noise Effects in Distributed Military Systems 1990 12 p Sponsored by Royal Netherlands Army (For primary document see N91-30362 22-32)

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On short range HF links, where the receiving station is relatively close to the transmitting station, reception of long delayed echoes (up to 20 ms) may occur due to backscatter. These backscatter signals will interfere with signals received through the legitimate path, which is either groundwave of nearly vertically incident skywave. Even on low data rate links this time dispersion of signals may cause intersymbol interference. In order to assess the influence of HF backscatter on short range HF data links, measurements were performed. Path delays were measured using a direct-sequence spread-spectrum technique. A carrier, BPSK (Binary Phase Shift Keying) modulated with a pseudo-noise (PN) sequence, was transmitted and the received signal was correlated with the same PN sequence. Measurements were taken in the Netherlands and Norway. The measurement results show that especially on the short range link, long delayed echoes appear. The backscatter effect depends on propagation conditions, thus on frequency, time of day, season, and solar activity. Author

N91-30367# Royal Aerospace Establishment, Farnborough (England). Dept. of Applied Ionospheric Physics and Flight Systems.

OPTIMUM ANTENNA SPACING FOR DIVERSITY IN METEOR BURST COMMUNICATIONS SYSTEMS

Paul S. Cannon, Anil K. Shukla, and Mark Lester (Leicester Univ., England) *In* AGARD, Use or Reduction of Propagation and Noise Effects in Distributed Military Systems 1990 13 p (For primary document see N91-30362 22-32)

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Temperate latitude meteor burst (MB) space diversity measurements, using cross correlation analysis of 37 MHz signals scattered over an 800 km path are reported. Signals of duration greater than or equal to 0.75 s, received on antennas separated by 5, 10, and 20 lambda, are investigated using 6 days of data collected over a 9-day period during February 1990. Signal decorrelation is shown to be achieved by antenna separation of 5 lambda, and there is no apparent variation in average cross correlation coefficient, for antenna separations between 5 and 20 lambda, for any of the signal categories examined. Author

N91-30368# Thomson-CSF, Gennevilliers (France).

ANALYSIS OF EXPERIMENTAL RESULTS WITH METEOR LINKS CARRIED OUT AT DIFFERENT RANGES AND FREQUENCIES

D. Sorais, O. Ravard, and L. Bertel (Rennes Univ., France) *In* AGARD, Use or Reduction of Propagation and Noise Effects in Distributed Military Systems 1990 14 p In FRENCH; ENGLISH summary (For primary document see N91-30362 22-32)

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The experimental results of meteor burst communications recorded at ranges from 100 to 1000 km are described. A physical interpretation of these results was obtained by using a statistical distribution of the meteor burst intervals and of the transfer function measurements. The resulting data base completes and improves the information provided by the traditional models. Author

N91-30369# SRI International Corp., Menlo Park, CA.

EXPERIMENTAL INVESTIGATION OF METEOR BURST FOOTPRINTS

M. Rich, P. Heilman, M. Murray, and B. Yetso *In* AGARD, Use or Reduction of Propagation and Noise Effects in Distributed Military Systems 1990 8 p (For primary document see N91-30362 22-32)

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Meteor Burst Communication (MBC) provides reliable, beyond-line-of-sight data communications, but some serious throughput limitations are associated with the technology. One limitation is the finite waiting time required to send a message. This waiting time can be reduced by increasing the excess link margin, but this increases the cost and complexity of an MBC system. However, because of the limited footprint of a meteor trail, the waiting time for a system of networked stations can be reduced by spreading the stations over multiple footprints. The effects of spatial diversity on link throughput are described, and preliminary observations of signal footprint size and shape are presented. Author

N91-30370# Communications Research Centre, Ottawa (Ontario).

EIGENVECTOR WEIGHTING AS AN ADAPTIVE ARRAY INTERFERENCE CANCELLATION TECHNIQUE

R. W. Jenkins and K. W. Moreland *In* AGARD, Use or Reduction of Propagation and Noise Effects in Distributed Military Systems 1990 13 p (For primary document see N91-30362 22-32)

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Adaptive antenna techniques normally make use of known properties of the desired signal, such as its direction or an embedded code, to distinguish it from interference. When this is not possible, algorithms such as power ratio inversion or Gram-Schmidt are used. These techniques tend to invert the relative powers of signals arriving at the array, and thus are effective when the interference is substantially stronger than the desired signal. However, when signal levels are close, such techniques fail. Analytic and modeling studies are presented of the eigenvector weighting technique. It is shown that this technique performs substantially better than power ratio inversion techniques. Like the power ratio inversion methods, eigenvector weighting is most effective when there is a large separation in signal powers. However, even when the signals are close in power, satisfactory cancellation can be achieved with eigenvector weighting for a large fraction of cases. The actual performance depends on array geometry and number of elements. Author

N91-30371# Naval Ocean Systems Center, San Diego, CA. Ocean and Atmospheric Sciences Div.

TECHNIQUES FOR ESTIMATING THE EFFECTS OF MAN-MADE RADIO NOISE ON DISTRIBUTED MILITARY SYSTEMS

D. B. Sailors *In* AGARD, Use or Reduction of Propagation and Noise Effects in Distributed Military Systems 1990 14 p (For primary document see N91-30362 22-32)

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Techniques are reviewed available for estimating the effects of man-made radio noise on distributed military systems using empirical man-made noise models. The models given in CCIR Report 258 are reviewed along with the empirical data base upon which they are based. Results of measurements of man-made noise are presented for six Pacific Ocean sites and for three Atlantic Ocean/Europe sites. Accumulative probability distribution models of increasing complexity are reviewed. Tests of fit of these distributions are presented for select samples of measured man-made noise data. Author

N91-30372# SRI International Corp., Arlington, VA. Information and Telecommunication Sciences Center.

TOWARD A GLOBAL MODEL OF HF OTHER-USER INTERFERENCE Abstract Only

G. H. Hagn *In* AGARD, Use or Reduction of Propagation and Noise Effects in Distributed Military Systems 1990 2 p (For primary document see N91-30362 22-32)

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Information on other-user interference (sometimes called co-channel interference) is important in predicting the performance of HF systems. A method is described for development of a regional model for HF other-user interference in terms of congestion for allocated bands. Congestion is defined as the fraction of the channels in an allocated band of contiguous channels with detected energy exceeding a specified threshold. A global congestion model might eventually be achieved as a combination of regional models. Author

N91-30373# University of Southern California, Los Angeles. Communication Science Inst.

TOPOLOGY-SELECTIVE JAMMING OF FULLY-CONNECTED, CODE-DIVISION RANDOM-ACCESS NETWORKS

Andreas Polydoros and Unjeng Cheng (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) *In* AGARD, Use or Reduction of Propagation and Noise Effects in Distributed Military Systems 1990 12 p (For primary document see N91-30362 22-32)

(Contract DAAL03-87-C-0007)

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The purpose is to introduce certain models of topology selective stochastic jamming and examine its impact on a class of fully-connected, spread-spectrum, slotted ALOHA-type random access networks. The theory covers dedicated as well as half-duplex units. The dominant role of the spatial duty factor is established, and connections with the dual concept of time selective jamming are discussed. The optimal choices of coding rate and link access parameters (from the users' side) and the jamming spatial fraction are numerically established for DS and FH spreading. Author

N91-30374# Norwegian Telecommunications Administration, Oslo.

SOME CONSIDERATIONS CONCERNING LOW NOISE RADIO RECEIVING SYSTEMS

Knut N. Stokke *In* AGARD, Use or Reduction of Propagation and Noise Effects in Distributed Military Systems 1990 13 p (For primary document see N91-30362 22-32)

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In order to get a good signal to noise ratio at very high frequencies (higher than 20 to 40 MHz), low noise amplifiers are often used. Such amplifiers should have a very low total noise factor (noise figure). Normally it is the noise factor of the first stage of an amplifier which is decisive for the total noise factor. Losses in the system will also influence the noise factor of the system. Consequently, the losses in cables and waveguides must be taken into account when considering the total noise factor. The thermal noise radiation from the surroundings may increase the noise temperature of an antenna. For reflector antennas, such as parabolic reflector antennas, the noise temperature is dependent on the elevation angle, but also on the form of the surroundings (mountains, hills, buildings, etc.). Author

N91-30375# Standard Elektrik Lorenz A.G., Pforzheim (Germany, F.R.).

PROPAGATION STUDIES OF A 60 GHz COMMUNICATION SYSTEM

H.-J. Ostertag *In* AGARD, Use or Reduction of Propagation and Noise Effects in Distributed Military Systems 1990 7 p (For primary document see N91-30362 22-32)

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Measurement equipment for 60 GHz propagation measurements is described. Measuring conditions and environments, and measurements with mobile and fixed transmitters are discussed. The results of the propagation measurements were helpful in designing a 60 GHz radio system. Author

N91-30376# Nebraska Univ., Lincoln. Dept. of Electrical Engineering.

UTILIZATION OR REDUCTION OF THE EFFECTS OF SEA CLUTTER FOR REAL AND SYNTHETIC APERTURE POLARIMETRIC RADARS

Ezekiel Bahar *In* AGARD, Use or Reduction of Propagation and Noise Effects in Distributed Military Systems 1990 7 p (For primary document see N91-30362 22-32)

(Contracts DAAL03-87-K-0085; N00014-87-K-0177)

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The principal elements of the full wave solutions are summarized. The full wave solutions are invariant to coordinate transformations and they satisfy the reciprocity, realizability, and duality relationships in electromagnetic theory. Limiting forms of the full wave solutions are shown to reduce to the low frequency small perturbation solutions and the high frequency physical optics solution. Thus, the full wave solution provides the only direct relationship between the low frequency perturbation and the high frequency physical optics solutions. Tracing this relationship was a rather elusive endeavor, since even for surfaces that simultaneously satisfy the small perturbation limitation and the large radii of curvature restriction, these two solutions are not in agreement. Thus, there are no complications in applying the full wave solutions to scattering by composite surfaces with multiple scales of roughness, and there is no need to adopt hybrid (perturbed physical optics) solutions based on artificial decomposition of the surface into two surfaces with different scales of roughness. These hybrid solutions critically depend on the choice of the spatial wave number at which it is assumed that the separation occurs between the large and the small scale surface. Author

N91-30377# McDonnell-Douglas Research Labs., Saint Louis, MO.

EMISSIVITY AND TRANSMISSIVITY OF A RANDOMLY LAMINAR STRUCTURE

Cornel Eftimiu *In* AGARD, Use or Reduction of Propagation and Noise Effects in Distributed Military Systems 1990 10 p (For primary document see N91-30362 22-32)

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Researchers considered a randomly laminar structure of constant width and investigated the scattering of scalar waves for

active remote sensing and radiometric purposes. The approach is based on analytic wave theory involving the expansion of the field in Wiener-Hermite functionals, which are statistically orthogonal. A hierarchy of approximations is established and shown to represent in each order a partial summation of perturbation theory terms. The average field as well as the incoherently scattered field are determined, yielding the emissivity and transmissivity of the randomly laminar medium. The special case of small correlation length is examined in detail and proved to fulfill the energy conservation requirement. Author

N91-30378*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE NASA RADIOWAVE PROPAGATION PROGRAM
Faramaz Davarian *In* AGARD, Use or Reduction of Propagation and Noise Effects in Distributed Military Systems 1990 6 p (For primary document see N91-30362 22-32)
(Contract NAS7-100)
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The objectives of the NASA radiowave Propagation Program are to enable new satellite communication applications and to enhance existing satellite communication networks. These objectives are achieved by supporting radio wave propagation studies and disseminating the study results in a timely fashion. Studies initiated by this program in the 1980s enabled the infant concept of conducting mobile communications via satellite to reach a state of relative maturity in 1990. The program also supported the satellite communications community by publishing and revising two handbooks dealing with radio wave propagation effects for frequencies below and above 10 GHz, respectively. The program has served the international community through its support of the International Telecommunications Union. It supports state of the art work at universities. Currently, the program is focusing on the Advanced Communications Technology Satellite (ACTS) and its propagation needs. An overview of the program's involvement in the ACTS project is given. Author

N91-30379# Hull Univ. (England). Communications Research Group.
COMBINING OF SIGNALS IN A GEOGRAPHICAL DIVERSITY SYSTEM
T. J. Speight *In* AGARD, Use or Reduction of Propagation and Noise Effects in Distributed Military Systems 1990 11 p (For primary document see N91-30362 22-32)
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A technique which will improve the performance of microscopic diversity processing while minimizing additional computational and communications channel overheads is described. The focus is on the use of such diversity processing in the high frequency environment. Author

N91-30380# Hull Univ. (England). Communications Research Group.
DISTRIBUTED LONG-RANGE RADIO SYSTEMS EMPLOYING MULTIPLE PROPAGATION MECHANISMS AND AN EXTENDED FREQUENCY RANGE
M. Darnell *In* AGARD, Use or Reduction of Propagation and Noise Effects in Distributed Military Systems 1990 12 p (For primary document see N91-30362 22-32)
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With the aid of data from real radio paths of different types, the concept of multiple propagation mechanism radio communication in the high frequency and low- very high frequency bands up to about 100 MHz is introduced. The radio system architecture necessary to exploit such a multiple mechanism environment is considered, with particular reference to the channel encoding and channel evaluation procedures required. Digital signal processing is assumed. Author

N91-30381# Hull Univ. (England). Communications Research Group.
A RELIABLE MULTI-USER DISTRIBUTIVE HF COMMUNICATIONS SYSTEM USING NARROWBAND CDMA
T. E. Miller *In* AGARD, Use or Reduction of Propagation and Noise Effects in Distributed Military Systems 1990 8 p Sponsored in part by Royal Airforce Establishment (For primary document see N91-30362 22-32)
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It is shown that the sequences and signals described can essentially provide the bearer signals in a code division multiple access (CDMA) communications system. A technique for modulating these bearer signals with information is discussed. The initial tests with this system show that it exhibits ideal properties for a reliable multi-user high frequency communications system. Simulated and field trials will be carried out to further demonstrate the effectiveness of these techniques over shared 3 kHz bandwidth high frequency single-side band channels. Author

N91-30382# Hull Univ. (England). Communications Research Group.
A DESIGN TESTBED FOR DISTRIBUTED V/UHF NETWORKS WITH MOBILE TERMINALS
Andrew Carnegie *In* AGARD, Use or Reduction of Propagation and Noise Effects in Distributed Military Systems 1990 8 p (For primary document see N91-30362 22-32)
Copyright Avail: NTIS HC/MF A13; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

A flexible design tool for mobile radio networks was implemented. Both low level areas such as modulation, coding, and synchronization, and high level techniques involving protocol details can be analyzed simultaneously. The simulation software is based on a Rayleigh fading channel model with a network layer protocol implementation. Described here is how a Rayleigh distribution can be generated and how it is used to implement the channel simulation by a conversion to a probability of error based on the modulation technique required. The network model is discussed with reference to the OSI Open Systems Interconnection reference model, and the variable configuration is described. To access the success of the system, an investigation into the use of variable, optimum length packets is illustrated. Author

N91-30383# Royal Aerospace Establishment, Farnborough (England).
DOPPLER-MULTIPATH TOLERANT VOICE COMMUNICATION
R. M. Harris *In* AGARD, Use or Reduction of Propagation and Noise Effects in Distributed Military Systems 1990 11 p (For primary document see N91-30362 22-32)
Copyright Avail: NTIS HC/MF A13; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

Line of sight communication between high performance aircraft has been found to be subject to a peculiar form of multipath radio wave propagation - Doppler multipath. It degrades analogue voice reception on the standard fit ultrahigh frequency radio, producing low frequency random noise and warbling. Various modifications were carried out on the aircraft's communications system, but the problem remained. All the evidence points to a natural phenomenon. The reported observations are corroborated by theoretical studies and laboratory simulations of multipath radio wave propagation between two points moving relative to a diffusely scattering reflector. Theoretical predictions of Rician fading have explained the disruption of speech transmitted using conventional dsb(am) modulation. This also indicated suppressing the carrier as a radical cure. Double sideband suppressed carrier radios have been developed for airborne evaluation in comparison with standard dsb(am). The air to air flying trials proved the superior performance of the suppressed carrier system under conditions of Doppler multipath. Author

N91-30384# Federal Aviation Administration, Atlantic City, NJ.
EVALUATION OF DESIRED TO UNDESIRED SIGNAL PROTECTION RATIOS OF 14 dB VERSUS 20 dB WITH FREQUENCY OFFSET
Arthur Cushnan, Kiem VanHoang, and Y. Truong Aug. 1991 15 p
(DOT/FAA/CT-TN91/15) Avail: NTIS HC/MF A03

This evaluation describes tests performed on eight avionics receivers at the Federal Aviation Administration (FAA) Technical Center to compare receiver performance when exposed to 14 and 20 decibel (dB) desired/undesired (D/U) co-channel interference. Testing was done with the undesired signal offset in frequency by small amounts to simulate real-world conditions. Test results indicate that at both D/U ratios, the receivers were able to reproduce clear, audible, and intelligible speech with or without the undesired frequency slightly offset. Author

N91-30385 Department of the Navy, Washington, DC.
AIR-SURFACE-MISSILE DATA LINK SYSTEM Patent
John C. Lockhart, Jr., inventor (to Navy), Standish C. Hartman, inventor (to Navy), Bruce R. Meuron, inventor (to Navy), and Joseph B. Lyons, Jr., inventor (to Navy) 2 Apr. 1991 9 p Filed 31 Aug. 64
(AD-D014920; US-Patent-5,004,185; US-Patent-Appl-SN-394388; US-Patent-Class-224-3.14) Avail: US Patent and Trademark Office CSCL 25/5

This invention relates to an aircraft missile communication system comprising means to generate a digital sequence corresponding to command signals, means in the aircraft to mix the digital command sequence with the code sequence and transmit the combination to an object; means to compare the received code sequence with the second digital code sequence and means in said object depended upon the comparing means to express said digital command sequence. Author (GRA)

N91-30386 Department of the Navy, Washington, DC.
PROGRESSIVE PHASE-ROTMAN-TURNER LENS FEED TRANSMISSION LINE NETWORK Patent
Arthur R. Skatvold, Jr., inventor (to Navy) 26 Mar. 1991 8 p Filed 27 Sep. 90
(AD-D014932; US-Patent-5,003,315; US-Patent-Appl-SN-590704; US-Patent-Class-342-373) Avail: US Patent and Trademark Office CSCL 09/1

A progressive phase feed transmission line network for use with a Rotman-Turner lens is composed of a plurality of feed ports for receiving or transmitting energy from or to the lens, a pair of control ports, a plurality of different sets of transmission line segments with the segments in the same sets being of substantially equal lengths, and a plurality of power directors for splitting or combining energy depending upon whether the network is operating in a receive or transmit mode. Different phase delays are interposed in the network to provide a passive arrangement which can operate in the receive mode to determine directionality of energy received by an antenna array and fed through a Rotman-Turner lens to the transmission line network or can operate in the transmit mode in a combination with adjusting of a phase shifter to directionally steer the energy launched into space by the antenna array after being fed from the network through the lens to the antenna array. GRA

N91-30387 Department of the Navy, Washington, DC.
RADIATOR OF MICROWAVE AND INFRARED ENERGY TO SIMULATE TARGET Patent
Kenny B. Foley, inventor (to Navy) 30 Apr. 1991 6 p Filed 30 Apr. 90
(AD-D014933; US-Patent-5,012,250; US-Patent-Appl-SN-516374; US-Patent-Class-342-53) Avail: US Patent and Trademark Office CSCL 14/2

A target simulates the coincident infrared and microwave signatures of a source being tracked by a missile whose systems are undergoing tests. GRA

N91-30388# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
AFIT/AFOSR SYMPOSIUM ON APPLICATIONS OF WAVELETS TO SIGNAL PROCESSING. VOLUME 1: SYNOPSIS Final Report, 3 Oct. 1990 - 30 Apr. 1991
Bruce W. Suter and Gregory T. Warhola 30 Apr. 1991 12 p Symposium held in Wright-Patterson AFB, OH, 20-22 Mar. 1991
(AF Proj. 2304)
(AD-A238024; AFIT-EN-TM-91-1-Vol-1) Avail: NTIS HC/MF A03 CSCL 12/1

The Air Force Institute of Technology (AFIT) hosted the Symposium on Applications of Wavelets to Signal Processing during 20 to 22 March 1991 at the AFIT Science and Research Center, Wright-Patterson AFB, OH. This was the first major academic meeting of its kind held at AFIT. The symposium was sponsored by the Air Force Office of Scientific Research (AFOSR), Bolling AFB, DC. It focused on applications of wavelets to problems in image and speech processing, communications, and graphics and opened with a one-day short course, A Tutorial on Wavelets. The symposium was attended by more than 220 researchers worldwide. They represented 15 foreign countries, 34 U.S. universities, 218 private industrial firms, 15 DoD organizations, and six non-DoD U.S. government organizations. Volumes 1 and 2 contain, respectively, a synopsis of the symposium and the complete set of tutorial notes. Author (GRA)

N91-30389# Signal Processing Technology Ltd., Palo Alto, CA.
ADVANCED TECHNIQUES FOR ARRAY PROCESSING Final Report, 1 Mar. 1989 - 30 Apr. 1991
Benjamin Friedlander 30 May 1991 14 p
(Contract DAAL03-89-C-0007)
(AD-A238218; ARO-26572.3-EL-S) Avail: NTIS HC/MF A03 CSCL 17/11

Array processing technology is expected to be a key element in communication systems designed for the crowded and hostile environment of the future battlefield. While advanced array processing techniques have been under development for some time, their practical use has been very limited. This project addressed some of the issues which need to be resolved for a successful transition of these promising techniques from theory into practice. The main problem which was studied was that of finding the directions of multiple co-channel transmitters from measurements collected by an antenna array. Two key issues related to high-resolution direction finding were addressed: effects of system calibration errors, and effects of correlation between the received signals due to multipath propagation. A number of useful theoretical performance analysis results were derived, and computationally efficient direction estimation algorithms were developed. These results include: self-calibration techniques for antenna arrays, sensitivity analysis for high-resolution direction finding, extensions of the root-MUSIC algorithm to arbitrary arrays and to arrays with polarization diversity, and new techniques for direction finding in the presence of multipath based on array interpolation. Author (GRA)

N91-30390*# Smithsonian Astrophysical Observatory, Cambridge, MA.
INVESTIGATION OF THE STRUCTURE OF THE ELECTROMAGNETIC FIELD AND RELATED PHENOMENA, GENERATED BY THE ACTIVE SATELLITE Semiannual Report No. 2, 1 Nov. 1990 - 30 Apr. 1991
Yakov L. Alpert Jul. 1991 48 p
(Grant NAG5-1340)
(NASA-CR-188758; NAS 1.26:188758) Avail: NTIS HC/MF A03 CSCL 20N

The altitude dependencies of the moduli of the electric field E in the VLF and LF frequency bands (f sub B much less than F less than f sub B) and in the altitude range of the ionosphere Z equals (400 to 2500) km up to Z equals 6000 km (the bottom of the magnetosphere) were calculated by the linear theory. The amplitudes of the field have large maxima in four regions: the axis field (E sub o) close to the direction of the Earth's magnetic field line B sub o, beta approximately 0 degrees, the fields (E sub

St), (E sub RevSt) and (E sub Res) in the Storey, Reversed Story and Resonance cones, beta approximately (0 approaches 20) degrees. Their maxima are very pronounced close to the low hybrid frequency F sub L. The nonlinear heating of the magnetoplasma under the action of an electric field Ee (sup iwt) was recently expanded by the macroscopic theory by the author. The velocities, collision frequencies and temperatures of all the constituents of a magnetoplasma - electrons, ions, and neutral particles - are taken into account. Formulae and numerical results are presented for the ionosphere in the frequency band F equals (1 to 10 exp 4) kHz and altitude range Z approximately (100 - 1000) km. Some results of calculations by the self consistent solution of the basis system of equations are also discussed. Author

N91-30391 Defence Research Establishment, Ottawa (Ontario).
ENERGY CONSUMPTION AND POWER REQUIREMENT FOR AN EHF SATCOM MANPACK TERMINAL
Claude Belisle Jan. 1989 45 p
(DREO-89-7; CTN-91-60191) Avail: NTIS HC A03

Tests of operation procedure options aimed at minimizing peak power and total energy consumption in man/team pack portable communications terminals for use with a satellite communication system operating at extremely high frequencies are described. Four operating procedures are presented and compared. (1) No restriction on communications modes are imposed, transmission and reception are performed simultaneously and continuously. This system would require 543 W of power and 13 kW hrs/day. (2) The operation of the terminal is divided into three non-concurrent modes, transmit, receive, and standby, with time allocation set at 5 percent for transmit, 45 percent for receive, and 50 percent for standby. This system would require 457 W power and use 3.7 kW hrs/day. (3) This procedure is similar to procedure 2 but the operation of the different elements is allowed only when their function is required. This system requires 1.7 to 2.1 kW hrs/day and a peak power of 379 W. (4) The last operating procedure employs diversity techniques, where the transmitted symbols are repeated a number of times to reduce the output transmission power requirements. This system would use from 200 to 379 W peak power and would consume form 1.7 to 2.1 kW hrs/day. It was recommended that an effort to control the periods of activation be made. Simultaneous transmission and reception of data should not be possible. Diversity levels of 3, 5, or 7 should be used. A power supply capable of delivering an average power of 200 W with a peak of 400 W and 2.1 kW hrs/day should be developed. CISTI

N91-30392*# Kansas Univ. Center for Research, Inc., Lawrence. Radar Systems and Remote Sensing Lab.
RAWS: THE SPACEBORNE RADAR WIND SOUNDER Annual Progress Report, 1991
Richard K. Moore Sep. 1991 16 p
(Grant NAG8-796)
(NASA-CR-188777; NAS 1.26:188777; RSL-TR-8760-3) Avail: NTIS HC/MF A03 CSCL 17I

The concept of the Radar Wind Sounder (RAWS) is discussed. The goals of the RAWS is to estimate the following three qualities: the echo power, to determine rain rate and surface wind velocity; the mean Doppler frequency, to determine the wind velocity in hydrometers; and the spread of the Doppler frequency, to determine the turbulent spread of the wind velocity. Researchers made significant progress during the first year. The feasibility of the concept seems certain. Studies indicate that a reasonably sized system can measure in the presence of ice clouds and dense water clouds. No sensitivity problems exist in rainy environments. More research is needed on the application of the radar to the measurement of rain rates and winds at the sea surface. Author

N91-30393*# Clarkson Univ., Potsdam, NY. Dept. of Electrical and Computer Engineering.
ANALYSIS OF ELECTROMAGNETIC INTERFERENCE FROM POWER SYSTEM PROCESSING AND TRANSMISSION COMPONENTS FOR SPACE STATION FREEDOM Interim Progress Report, 1 Jan. - 31 Aug. 1991
Peter W. Barber, Nabeel A. O. Demerdash, R. Wang, B. Hurysz, and Z. Luo 1991 224 p
(Grant NAG3-1126)
(NASA-CR-186564; NAS 1.26:186564) Avail: NTIS HC/MF A10 CSCL 20N

The goal is to analyze the potential effects of electromagnetic interference (EMI) originating from power system processing and transmission components for Space Station Freedom.The approach consists of four steps: (1) develop analytical tools (models and computer programs); (2) conduct parameterization studies; (3) predict the global space station EMI environment; and (4) provide a basis for modification of EMI standards. Author

N91-30394# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany, F.R.). Abt. HF-Physik.
NUMERIC SOLUTION OF THE ELECTRIC FIELD INTEGRAL EQUATION USING GALERKIN'S METHOD FOR AXISYMMETRIC CASES Ph.D. Thesis - Technische Univ.
Klemens Lileg Dec. 1990 133 p In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-1264) Sponsored by Oesterreichische Fonds zur Foerderung der Wissenschaftlichen Forschung
(DLR-FB-90-58; ISSN-0939-2963; ETN-91-99789) Avail: NTIS HC/MF A07; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 43 DM

The electric field integral equation is solved for a cylindrical antenna of arbitrary radius with flat endcaps using the method of moments. Trigonometric subdomain functions are used as basis functions; the weighting functions have the same shape as the basis functions (Galerkin's method). For the endcaps the approximation of the program NEC is used; the excitation is due to a homogeneous field in a gap in the center of the antenna. No analytical approximations are employed in the evaluation of the integrals needed for the computation of the impedance matrix. The admittance so obtained converges better than that found with the help of NEC, but in many cases it is not completely satisfactory. Therefore, the approximate condition for the endcaps are introduced, and trigonometric subdomain functions analogous to those used on the cylinder are used as basis functions. All additional evaluations are done without approximations. The results for the admittance converge in all cases even for a small number of segments. The impedance is measured for a number of monopoles of various radii above a conducting plane; for all frequencies good agreement with the calculation is obtained. ESA

N91-30395# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany, F.R.). Abt. HF-Systeme.
CROSS-CALIBRATION BETWEEN AIRBORNE SAR SENSORS
Manfred Zink Feb. 1991 57 p
(DLR-FB-91-10; ISSN-0939-2963; ETN-91-99791) Avail: NTIS HC/MF A04; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 22 DM

As synthetic Aperture Radar (SAR) system performance and experience in SAR signature evaluation increase, quantitative analysis becomes more and more important. Such analyses require an absolute radiometric calibration of the complete SAR system. To keep the expenditure on calibration of future multichannel and multisensor remote sensing systems (e.g., X-SAR/SIR-C) within a tolerable level, data from different tracks and different sensors (channels) must be cross calibrated. The 1989 joint E-SAR/DC-8 SAR calibration campaign gave a first opportunity for such an experiment, including cross sensor and cross track calibration. A basic requirement for succesful cross calibration is the stability of the SAR systems. The calibration parameters derived from different tracks and the polarimetric properties of the uncalibrated data are used to describe this stability. Quality criteria for a successful cross calibration are the agreement of alpha degree values and the consistency of radar cross sections of equally sized corner reflectors. Channel imbalance and cross talk provide additional quality in case of the polarimetric DC-8 SAR. ESA

N91-30396# European Space Agency, Paris (France).
UTILIZATION OF HIGHER FREQUENCIES FOR SATELLITE COMMUNICATIONS: DETERMINATION OF ATMOSPHERIC INFLUENCES BY EXPERIMENTS AND MODELS Ph.D Thesis - Hochschule der Bundeswehr, 1989
Arno Schroth (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen, Germany, F.R.) May 1991 600 p Transl. into ENGLISH of Neue Frequenzbereich fuer den Satellitenfunk - Experimentelle und Modellmaessige Bestimmung der Atmospaereneinfluesse (Oberpfaffenhofen, Fed. Republic of Germany, DLR), Aug. 1989 511 p Original language document was announced as N90-24518
(ESA-TT-1211; DLR-FB-89-46; ETN-91-99798) Avail: NTIS HC/MF A25; Original German version available from DLR, Wissenschaftliches Berichtswesen, VB-PL-D0, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, 180 DM

The future satellite communications (20 GHz to 50 GHz) and related technical developments are briefly presented, and the basic limitations due to propagation effects are indicated. The goals envisaged with Olympus and Italsat satellites are presented together with the corresponding experimental programs. RF channel models for system planning are derived and discussed. Techniques and equipment for determining atmospheric influences on Earth to satellite links are discussed. Following the description of the measuring instruments, the measuring capabilities of the (DLR) radar are demonstrated. ESA

N91-30397 Physics and Electronics Lab. TNO, The Hague (Netherlands).
DETECTION OF MILITARY OBJECTS USING MULTI SPECTRAL IMAGE PROCESSING Interim Report
J. P. G. M. Derckx Jan. 1991 54 p
(Contract A90/KL/655)
(FEL-90-A196; TD-90-2473; ETN-91-99809) Copyright Avail: Physics and Electronics Lab. TNO, P.O. Box 96864, 2509 JG The Hague, Netherlands

The detection of military objects in infrared imagery is strongly influenced by the amount of clutter in the background. It influences the detection scores and the time required for the detection. With image processing techniques, clutter can be reduced. It most cases, however, considerable amount of clutter still remains. Combining the infrared (IR) images of the same scene, recorded at different, suitability chosen, wavelength bands, can further reduce clutter. A program which analyzes multispectral imagery in order to minimize false alarms due to clutter and to optimize the detection probabilities of military vehicles is described. Tests of the program indicate that by analyzing IR imagery in combination with imagery in two visual bands of the same scene, and comparing this result with the result of the analysis of the IR image alone, clutter can be greatly reduced. ESA

N91-30398 Physics and Electronics Lab. TNO, The Hague (Netherlands).
SOME BASIC CONSIDERATIONS CONCERNING TIME-DOMAIN MEASUREMENTS WITH ELECTROMAGNETIC-FIELD SENSORS Final Report
J. J. A. Klaasen Nov. 1990 25 p
(Contract A86/K/012)
(FEL-90-A222; TD-90-2773; ETN-91-99810) Copyright Avail: Physics and Electronics Lab. TNO, P.O. Box 96864, 2509 JG The Hague, Netherlands

Some ideas concerning time domain measurements with electromagnetic field sensors, and how the time domain measurements can be performed are presented. A very simple method is enunciated to correct the influence of the low cutoff frequency of the sensor. It is shown that the low cutoff frequency of the sensor can be found from its time-domain response to a Nuclear Electromagnetic Pulse (NEMP). The practical value of this method is demonstrated by experiments. Time domain calibration of electromagnetic field sensors is addressed. The influence of the bandwidth of the measuring system is investigated. It is found that the influence of the bandwidth can be compensated. ESA

N91-30399 Physics and Electronics Lab. TNO, The Hague (Netherlands).
ANALYSIS OF A TWISTING CASSEGRAIN ANTENNA Final Report
C. B. Y. Leroy Jan. 1991 106 p
(Contract A84/K/025)
(FEL-90-A299; TD-90-4056; ETN-91-99813) Copyright Avail: Physics and Electronics Lab. TNO, P.O. Box 96864, 2509 JG The Hague, Netherlands

Modeling of a twisting cassegrain monopulse antenna is discussed. A combination of fundamental electromagnetic field theory and a quasi optical approach is applied for the analysis of the crosspolar isolation performance of this type of antenna. Assumptions, limitations and features of the model are highlighted. Crosspolar power isolation is calculated as a function of frequency, polarization angle and antenna dimensions. Contour plots and 3-D plots of antenna sum patterns for the crosspolar and the copolar case are provided. The theory is compared with measurements for a specific twisting cassegrain antenna. ESA

N91-30400 Physics and Electronics Lab. TNO, The Hague (Netherlands).
LATPET: A VERSATILE COMPUTER PROGRAM TO ANALYSE THE PERFORMANCE OF LOW ANGLE TRACKER ALGORITHMS IN A DISTURBED ENVIRONMENT Final Report
A. Theil Dec. 1990 44 p
(FEL-90-B345; TD-90-4052; ETN-91-99816) Copyright Avail: Physics and Electronics Lab. TNO, P.O. Box 96864, 2509 JG The Hague, Netherlands

The Low Angle Tracker Performance Evaluation Tool (LATPET) is a computer program with which the track accuracy of array radars can be investigated. The program considers a maritime scenario characterized by the presence of multipath reflections. Several techniques used to estimate the target height are implemented within LATPET: maximum likelihood model fitting and the spectral methods DFT and MUSIC. Environmental factors that bring about height estimate distortion are discussed. LATPETS's features and capabilities as well as some results of simulations are presented. ESA

N91-30401# Royal Signals and Radar Establishment, Malvern (England).
ANALYSIS OF THE PHONEME RECOGNITION PERFORMANCE OF THE ARM CONTINUOUS SPEECH RECOGNITION SYSTEM
S. R. Browning 21 Mar. 1991 38 p
(RSRE-Memo-4463; BR302014; ETN-91-99846) Copyright Avail: NTIS HC/MF A03

The results of a phonetically motivated analysis of the speech recognition system developed as part of the ARM (Airborne Reconnaissance Mission) project are presented. The aim of the work described was to investigate to what extent errors can be explained by phonetic effects; those which cannot may indicate where models may be improved. The background to the investigations, and the problems of evaluating phoneme recognition performance are described. Detailed analysis of specific types of errors are considered, motivated by a desire to find phonetic explanations of them. ESA

N91-30402# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Standards Approval Board for Space Data Communications.
PACKET TELECOMMAND STANDARD
Jun. 1990 169 p
(ESA-PSS-04-107-Issue-1; ISSN-0379-4059; ETN-91-99530)
Copyright Avail: NTIS HC/MF A08

A standard to establish uniform requirements for the implementation of spacecraft packet telecommand systems by ESA is presented. The standard establishes a framework and basis for ESA spacecraft telecommand stream data structures, allows spaceborne telecommand systems compatible with ESA ground systems to be implemented, potentially provides high level commonality between spaceborne and ground based telecommand

systems, and provides recommendations for a minimum acceptable level of end to end performance for telecommand systems conforming to the standard. The standard applies to all spacecraft using the ESA ground network standard facilities and services. ESA

N91-30403# Norwegian Defence Research Establishment, Kjeller.
MEASUREMENT OF RCS FOR A MOVING TARGET BY USE OF MEDIUM-PRF RADAR
Jan Erik Haakegaard 13 Dec. 1990 98 p In NORWEGIAN; ENGLISH summary
(FFI-90/7047; ISSN-0802-2437; ETN-91-99539) Avail: NTIS HC/MF A05

Earlier target classifications were done using a continuous wave radar. These made it possible to choose a sampling rate high enough to avoid aliasing in the frequency spectrum of the echo signal. The possibility of using the same measuring analysis with a medium Pulse Recurrency Frequency (PRF) Radar, which can have a PRF from 10 to 20 kHz is investigated. This is below bandwith of the echo signal, and aliasing is introduced. The frequency spectrum can be recreated by using several PRF's. Two techniques are developed to do this, and they are programmed and tested. The results show that it is possible the recreate some of the spectrum but it will be difficult to recreate enough to be able to classify targets. ESA

N91-30404# Norwegian Defence Research Establishment, Kjeller.
IONOSPHERIC HF RADIO PROPAGATION AT HIGH LATITUDES USING CONVENTIONAL AND SPREAD SPECTRUM MODULATION
Vivianne Jodalen, Eivind Thrane, Ingvar Koltveit, and Trond Hellum 25 Feb. 1991 182 p
(FFI-91/7003; ISSN-0802-2437; ETN-91-99540) Avail: NTIS HC/MF A09

An experimental program is considered whose aims are: to obtain a statistical description of the properties of ionospheric communication channels within and to the auroral zone; to study the dependence of the availability of the ionospheric channel on geophysical disturbances; to study the capabilities of the ionospheric channel to carry a broadband signal with a complex digital modulation; to compare the experimental results with the current ionospheric models, as represented by the prediction codes; to use the results to improve frequency prediction at high latitudes. Preliminary results pertaining to the first four items in the list are described. The experimental program is still in progress and more results will be forthcoming. ESA

N91-30405# Technische Univ., Eindhoven (Netherlands). Faculty of Electrical Engineering.
DATA ACQUISITION AND SIGNAL PROCESSING/ANALYSIS OF SCINTILLATIONS EVENTS FOR THE OLYMPUS PROPAGATION EXPERIMENT
A. D. Sarma and M. H. A. J. Herben Dec. 1989 74 p
(EUT-89-E-232; ISBN-90-6144-232-X; ISSN-0167-9708; ETN-91-99616) Avail: NTIS HC/MF A04

The principles of data acquisition of scintillation events to be gathered during the Olympus propagation experiments are reported. After a summary of the errors associated with digital sampling and a review of the scintillation theory, suitable bandwidths are selected for two different experimental set ups. The procedure to decide the characteristics of the baseband filters, from the basic theory of amplitude and phase scintillation variance and spectral density function, is described, considering different types of analog and digital filters. A logic circuit to start the sampling of the signals automatically, when the scintillation intensity exceeds a specified level, is presented. Development of an atmospheric turbulence probe measuring wet and dry bulb temperature fluctuations to support the radio wave measurements are described and computer programs for scintillation data analysis are detailed. The realized experimental set ups are tested using the 11.45 GHz beacon signal of the European communication satellite and the signals from the atmospheric turbulence probe. ESA

N91-30406# Technische Univ., Eindhoven (Netherlands). Faculty of Electrical Engineering.
ON THE ACCURACY OF RADIOWAVE PROPAGATION MEASUREMENTS: OLYMPUS PROPAGATION EXPERIMENT M.S. Thesis
P. H. G. vandeBerg Nov. 1990 191 p
(EUT-90-E-245; ISBN-90-6144-245-1; ISSN-0167-9708; ETN-91-99625) Avail: NTIS HC/MF A09

The design and analysis of a preprocessing system for the Olympus Propagation Experiment (OPEX) are addressed. Methods to perform bias removal are discussed and analyzed. EUT (Eindhoven University of Technology, Holland) measurements were used to evaluate the effectiveness of these bias removal methods. It may be concluded that for attenuation measurements, radiometer measurements are necessary to obtain copolar reference levels. For crosspolar measurements at 12.5 and 30 GHz, adaptive cancellation is recommended. A method was developed to estimate the uncertainty of propagation data in practice. Subsequently algorithms were developed for the EUT preprocessing system, that will be part of the EUT processing system for event analysis. For statistical analysis, a standard processing system, 'DAPPER', will be used. A prototype of DAPPER preprocessing was supplied to the EUT and has been tested. This system is under development and will be submitted to all OPEX members. Test with real propagation data show several errors and practical problems in the software system. Some examples of the output of the preprocessing system are discussed. ESA

N91-30407# Technische Univ., Eindhoven (Netherlands). Faculty of Electrical Engineering.
A SYNTHESIS METHOD FOR COMBINED OPTIMIZATION OF MULTIPLE ANTENNA PARAMETERS AND ANTENNA PATTERN STRUCTURE
P. J. I. deMaagt Nov. 1990 92 p
(EUT-90-E-246-X; ISBN-90-6144-246-X; ISSN-0167-9708; ETN-91-99626) Avail: NTIS HC/MF A05

An analytical approach of antenna synthesis is addressed. It presents an optimization method which is based on writing the design criteria as a ratio of two quadratic Hermitian forms, so that more than one antenna parameter (such as antenna efficiency and beam efficiency) can be optimized simultaneously, with and without pattern structure constraints. The mathematical formulation is given, and the optimization method is discussed with and without constraints for the far field pattern. A comparison is made with the results obtained by others and examples are given. This clearly shows the capability and correctness of the optimization procedure. ESA

N91-30408# Universiteit Twente, Enschede (Netherlands). Tele-Informatics and Open Systems Group.
PROPOSAL FOR AN AAL SERVICE DEFINITION Preliminary Study, Nov. - Dec. 1990
R. A. Sturrus Dec. 1990 61 p
(Memo-INF-90-89; ISSN-0923-1714; ETN-91-99680) Avail: NTIS HC/MF A04

A service definition of the AAL (ATM (Asynchronous Transfer Model) Adaptation Layer) in terms of service primitives and time sequence diagrams is presented. The AAL is a layer of the B-ISDN. The service definition of the AAL is necessary to be able to determine the functionality needed in the AAL, but also to determine the functionality in the MMCC (Multi Media Conference Call) layer on top of the AAL. This layer extends the AAL service to the B-ISDN (Broadband-Integrated Services Digital Network) Service. An iterative approach is used to determine the AAL service. First step is to make an inventory of service aspects of the AAL described in the CCITT (Consultative Committee for International Telephone and Telegraph) recommendation 1.362 and 1.363. Second step is to determine which functionality is needed in the MMCC layer to support the B-ISDN service. Because many gaps in CCITT's service definition of the AAL exist, several scenarios

are possible. The gaps give space to assumptions about the functionality that is or is not present in step two. The fourth step (which is not carried out) is to determine in more detail the functionality of the MMCC Layer. Additional iteration steps can be made to converge to a more detailed description of the AAL service and the MMCC Layer. ESA

N91-30409# Universiteit Twente, Enschede (Netherlands). Tele-Informatics and Open Systems Group.
A HIGH-SPEED SLOTTED RING ACCESS MECHANISM WITH DYNAMICALLY ADAPTIVE SLOT SIZES
H. L. Pasch and I. G. Niemegeers Mar. 1991 8 p
(Memo-INF-91-21; TIOS-91/0014; ISSN-0923-1714; ETN-91-99701) Avail: NTIS HC/MF A02

Two access mechanisms complementary in performance are the token ring and the slotted ring. While the token ring outperforms the slotted ring for long messages, the latter performs significantly better for short messages. The factor that causes this difference is the number of tokens on the ring. A new network design in which this factor has been made adaptive, resulting in a network that can be made to behave like both the token ring the slotted ring, or anything in between, i.e.. it performs optimally for any given message length, is proposed. Simulation results that show the performance gain that is achieved by using this principle are presented. The concept of transmission interruption, which intends to approach the shortest job next preemptive resume service' discipline in order to further minimize the mean transfer delay in case of a load consisting of a mixture of message lengths, is introduced. ESA

N91-30410*# Arizona State Univ., Tempe. Dept. of Electrical Engineering.
ANTENNA PATTERN CONTROL USING IMPEDANCE SURFACES Semiannual Progress Report, 16 Mar. - 15 Sep. 1991
Constantine A. Balanis and Kefeng Liu Sep. 1991 28 p
(Grant NAG1-1183)
(NASA-CR-188801; NAS 1.26:188801) Avail: NTIS HC/MF A03 CSCL 20N

The implementation of a moment method code for the analysis of horn antennas was accomplished. The code can analyze the antenna with or without lossy material coatings. It predicts the antenna gain, voltage standing wave ratio (VSWR) on the feeding waveguide, the existing modes on the radiating aperture, and radiation patterns of the antenna. Many computations were performed on three pyramidal horn antennas, and their radiation and VSWR's are presented and compared with experimental data. Although the code is still being finalized, some discussions on using the code are included. Author

33 ELECTRONICS AND ELECTRICAL ENGINEERING

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics.*

N91-30411# Pennsylvania State Univ., University Park. Dept. of Chemistry.
IN SITU ACTIVATION OF CARBON FIBER MICRODISK ELECTRODES
Timothy G. Strein and Andrew G. Ewing 19 Nov. 1990 32 p
(Contract N00014-90-J-1161)
(AD-A229470) Avail: NTIS HC/MF A03 CSCL 09/1

Carbon fiber microdisk electrodes (11 micron in diameter) were activated in situ via intense laser pulses produced by a small nitrogen laser. The laser beam was focussed down to a small spot size to ensure adequate power density. The laser treatment resulted in more Nernstian voltammetry for dopamine, 4-methylcatechol, and 3, 4-dihydroxyphenylacetate in several different buffer systems over a range of pH. The effect of buffer composition and pH on the apparent electrode kinetics observed both before and after laser treatment was studied. An apparent cleaning of the electrode surface by the laser pulses results in more Nernstian voltammetry; however, voltammograms obtained in some buffer systems, particularly those containing citrate, show anomalous effects after laser treatment. A model of the activation process is presented which might explain the observed phenomenon by surface ablation exposing clean, active carbon, followed by adsorption of solution species. This activation procedure is presented as a simple, fairly inexpensive way to obtain consistent, repetitive voltammetry at carbon fiber microdisk electrodes. GRA

N91-30412# State Univ. of New York, Buffalo.
THERMOELECTRIC PHENOMENA IN METALS UNDER LARGE TEMPERATURE GRADIENTS
A. N. Grigorenko, P. I. Nikitin, Daniel A. Jelski, and Thomas F. George Dec. 1990 12 p
(Contract N00014-90-J-1193)
(AD-A229548; UBUFFALO/DC/90/TR-36) Avail: NTIS HC/MF A03 CSCL 09/1

Nonlinear contributions to thermoelectricity are studied when large temperature gradients are present in metals. A theory is presented to account for these phenomena in the case of monovalent metals obeying a parabolic dispersion law. Simple experiments are proposed in which nonlinear terms are relevant and produce measurable effects. GRA

N91-30413# State Univ. of New York, Buffalo.
COOPERATIVE ABSORPTION-INDUCED CHARGE TRANSFER IN A SOLID
Isidore Last and Thomas F. George Dec. 1990 21 p Submitted for publication
(Contract N00014-90-J-1193)
(AD-A229553; UBUFFALO/DC/90/TR-37) Avail: NTIS HC/MF A03 CSCL 09/1

Cooperative electronic excitation involving electron transfer among guest molecules in a solid is considered. The mutual interaction between two guest molecules with large dipole moments in excited states can lead to cooperative processes (two-electron transfer) which are forbidden in the absence of such interaction. The cooperative transition moments are calculated for coupled pairs of XeCl molecules within an Ar matrix at sum and difference frequencies. GRA

N91-30414# Illinois Univ., Urbana. Coordinated Science Lab.
ASYMPTOTIC AND ABSORBING BOUNDARY CONDITIONS FOR FINITE ELEMENT ANALYSIS OF DIGITAL CIRCUIT AND SCATTERING PROBLEMS
Ahmed Kheblir and Raj Mittra 8 Nov. 1990 129 p
(Contract N00014-90-J-1270)
(AD-A229564; UILU-ENG-90-2252) Avail: NTIS HC/MF A07 CSCL 09/1

The finite element method (FEM) is very appealing for solving open region digital circuit and scattering problems due to its simplicity in modeling complex-shaped structures and inhomogeneous dielectric scatterers. However, it must deal with the practical problems of mesh truncation and the introduction of an artificial outer boundary in order to limit the number of node points to a manageable size. Therefore, the major difficulty encountered when using FEM is how to find a boundary condition operator which when applied on the artificial outer boundary mimics the asymptotic behavior of the field at infinity and yields reasonably accurate results in the interior region without the need of an exorbitantly large number of mesh points. This report is an effort to provide some techniques to deal with the FEM mesh truncation, in an efficient manner, through the introduction of three new boundary condition concepts, viz., the boundary conditions for arbitrary outer boundaries, the asymptotic boundary condition for digital circuit applications, and the higher-order asymptotic and absorbing boundary conditions. The use of generalized boundary conditions or the boundary conditions for arbitrary outer boundaries

enables one to reduce the number of node points significantly and to solve larger sized problems than had been possible in the past. GRA

N91-30415# Illinois Univ., Urbana. Coordinated Science Lab.
EFFICIENT EVALUATION OF THE INNER PRODUCTS IN THE SPECTRAL DOMAIN ANALYSIS OF MICROSTRIP DISCONTINUITIES
Dan McNay and Raj Mittra Nov. 1990 68 p
(Contract N00014-90-J-1270)
(AD-A229607; UILU-ENG-90-2254) Avail: NTIS HC/MF A04 CSCL 09/1

The current trend in microwave and millimeter-wave integrated circuits (MICs) is toward higher operating frequencies, high packing densities, and more stringent performance requirements. As a result, earlier models based on approximate analysis techniques are becoming insufficiently accurate for use in computer-aided design (CAD) packages. In particular, simplifying assumptions, such as the quasi-static approximation and the magnetic wall approximation, are becoming inappropriate in the analysis of microstrip discontinuities such as bends, steps, and stubs. Instead, a rigorous full-wave analysis is needed to obtain a more accurate characterization of thes passive circuits. Such an analysis captures the increasingly significant effects of coupling, dispersion, and radiation. The objective of this study is to develop an asymptotic acceleration technique for the efficient evaluation of the integrals involved in the full-wave spectral domain method for analyzing microstrip discontinuity problems. (kr) GRA

N91-30416# Columbia Univ., New York, NY. Microelectronics Science Lab.
INTERFACIAL AND THIN FILM CHEMISTRY IN ELECTRON DEVICE FABRICATION Annual Letter Report, 15 Sep. 1989 - 14 Sep. 1990
G. Flynn, R. Osgood, D. Auston, E. Fossum, and N. Turro 20 Nov. 1990 76 p
(Contract N00014-86-K-0694)
(AD-A229609) Avail: NTIS HC/MF A05 CSCL 09/1

The fourth year's progress on the Columbia URI program on Interfacial and Thin-Film Chemistry in Electron Device Fabrication is reported. Progress has been made in three broad areas: Molecular Beam Epitaxy (MBE) Growth and Devices, Laser Surface Interactions, and Fundamentals of Processing Gas/Surface Interactions. Examples of specific results include the first study of laser-assisted Cl2 etching of copper, many new tunnelling and optical devices in layered semiconductors; a new 2-phase 2 deg charge coupled device (CCD); seminal studies of the Si-YBaCuO system; and the first observation of thin film growth by photoelectron injection. GRA

N91-30417# Sandia National Labs., Albuquerque, NM.
SHIELDED CABLES WITH OPTIMAL BRAIDED SHIELDS
E. Homann (Rheinische Draht- und Kabelwerke, Cologne-Riehl, Germany, F.R.) 24 Jan. 1991 30 p Transl. into ENGLISH from Nachrichtentechnische Zeitschrift (Fed. Republic of Germany), no. 3, 1968 p 155-161
(Contract DE-AC04-76DP-00789)
(DE91-011303; ALS/TR-91-002) Avail: NTIS HC/MF A03

Extensive tests were done in order to determine what factors govern the design of braids with good shielding effectiveness. The results are purely empirical and relate to the geometrical relationships between the braid parameters. The influence of various parameters on the shape of the transfer impedance versus frequency curve were investigated step by step. It was found that the optical coverage had been overestimated in the past. Good shielding effectiveness results not from high optical coverage as such, but from the proper type of coverage, which is a function of the braid angle and the element width. These dependences were measured for the ordinary range of braid angles (20 to 40 degrees). They apply to all plaiting machines and all gages of braid wire. The design rules are largely the same for bright, tinned, silver-plated and even lacquered copper wires. A new type of braid, which has marked advantages over the conventional design, was proposed. With the 'mixed-element' technique, an optimal braid design can be specified on any plaiting machine, for any possible cable diameter, and for any desired angle. This is not possible for the conventional type of braid. DOE

N91-30418*# Analex Corp., Brook Park, OH.
PHYSICAL OPTICS FOR OVEN-PLATE SCATTERING PREDICTION Final Report
J. Baldauf (Illinois Univ., Urbana.) and K. Lambert Jul. 1991 14 p
(Contract NAS3-25776)
(NASA-CR-187140; E-6272; NAS 1.26:187140) Avail: NTIS HC/MF A03 CSCL 09C

An oven assembly design is described, which will be used to determine the effects of temperature on the electrical properties of materials which are used as coatings for metal plates. Experimentally, these plates will be heated to a very high temperature in the oven assembly, and measured using a microwave reflectance measurement system developed for the NASA Lewis Research Center, Near-Field Facility. One unknown in this measurement is the effect that the oven assembly will have on the reflectance properties of the plate. Since the oven will be much larger than the plate, the effect could potentially be significant as the size of the plate becomes smaller. Therefore, it is necessary to predict the effect of the oven on the measurement of the plate. A method for predicting the oven effect is described, and the theoretical oven effect is compared to experimental results of the oven material. The computer code which is used to predict the oven effect is also described. Author

N91-30419* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
SYNCHRONOUS DEMODULATOR Patent
John F. Sutton, inventor (to NASA) 14 May 1991 9 p Filed 29 Sep. 1989
(NASA-Case-GSC-13179-1; US-Patent-5,015,963;
US-Patent-Appl-SN-414815; US-Patent-Class-329-361;
US-Patent-Class-329-349; US-Patent-Class-307-353;
Int-Patent-Class-H03D-1/04) Avail: US Patent and Trademark Office CSCL 09A

A synchronous demodulator is presented that includes a switch which is operated in synchronism with an incoming periodic signal and both divides and applies that signal to two signal channels. The two channels each include a network for computing and holding, for a predetermined length of time, the average signal value on that channel and applies those values, in the form of two other signals, to the inputs of a differential amplifier. The networks may be R-C networks. The output of the differential amplifier may or may not form the output of the synchronous detector and may or may not be filtered. The output will not include a periodic signal due to the presence of a dc offset. Additionally, the output will not contain any substantial ripple due to periodic components in the input signal. In a somewhat more complex version, containing twice the structural components of the above synchronous demodulator with a more complex switching mechanism, essentially all ripple due to periodic components in the input signal are eliminated.
Official Gazette of the U.S. Patent and Trademark Office

N91-30420 Tel-Aviv Univ. (Israel). Dept. of Fluid Mechanics and Heat Transfer.
STATIC CAPACITY MODEL FOR SEALED NICKEL CADMIUM CELLS M.S. Thesis
Jacob Lomaniec Apr. 1989 102 p In HEBREW; ENGLISH summary Prepared in cooperation with TADIRAN Israel Electronics Industries Ltd., Rehovot
(ITN-91-85144) Copyright Avail: Tel-Aviv Univ., Exact Sciences Library, Ramat Aviv 69978, Israel

A model was developed for calculating the capacity of nickel cadmium rechargeable sealed cells. The model applies only to the following operating conditions for a cell of capacity C ampere-hours: Temperature of 20 + or - 5 C; charging for 16 hr, at 0.1 C amp; discharging at 0.2 C amp until the terminal voltage

falls to 1.0 V. The study considers the dimensional and quantitative relationships among the cell's chemical and mechanical components, and the application of these relationships to optimizing cell design in terms of energy density and electrical performance. The model comprises several components, representing the several stages of the manufacturing process: assembling the electrodes and separator in a cylindrical can; production of porous, sintered nickel plaque on a perforated steel substrate; impregnating the plaque with active material; oxidation of the sintered nickel during impregnation; insertion and concentration of the electrolyte solution. Results from the model were compared with those obtained from cells manufactured during a long period. Good agreement was obtained. The models were used in the plant, to define the operating parameters of various production stages and contributed to a general improvement in product quality. The models were also applied to the optimization of new cell designs, and reduction of development costs by the elimination of much experimental work. ISA

N91-30421 Department of the Navy, Washington, DC.
ELECTRORHEOLOGICALLY DAMPED IMPACT SYSTEM Patent
Lee R. Hardt, inventor (to Navy) 7 May 1991 6 p Filed 5 Jan. 90
(AD-D014934; US-Patent-5,012,740; US-Patent-Appl-SN-461566; US-Patent-Class-102-216) Avail: US Patent and Trademark Office CSCL 19/1

An impact switch is described having a housing containing a rigid coaxial conductor entering one end. An inner cylindrical contact extends axially inward from and beyond the in housing end of an outer tubular contact which has a spiral spring extending axially from within a recess therein. The free end of the spring supports a mass spaced from the end of the inner contact. The contacts, spring and mass are enclosed within a flexible shroud spaced from the inner wall of the housing. The space between the shroud and housing contains an electrorheological fluid, the viscosity of which is a function of the voltage supplied by two electrodes extending through the housing and into the fluid. The voltage controlled viscosity permits control of damping of the shroud, mass, and spring movements in response to impact caused switch deceleration and control of time for switch closure and fuze delay by means of mass contact with the inner cylindrical contact, or spring contact with the outer tubular contact. GRA

N91-30422# Stanford Univ., CA. Dept. of Electrical Engineering.
JOINT SERVICES ELECTRONIC PROGRAM Final Report, 1 Jul. 1988 - 10 Jun. 1991
James S. Harris Jun. 1991 22 p
(Contract DAAL03-88-C-0011)
(AD-A238463; ARO-25602.3-EL) Avail: NTIS HC/MF A03 CSCL 20/12

The research program was divided into main areas: Semiconductor Materials, Processes and Circuits, and Information Systems. The work units and tasks within each of the above areas are summarized below. Semiconductor Materials, Processes and Circuits: (1) Molecular Beam Epitaxy of High T sub c Superconductors; (2) Physics and Applications of Ultra-Small, High Temperature Superconductors; (3) Reactive Ion Profiling of Heterostructure; (4) GaAs on Si Integrated Circuits; (5) The Electronic Structure and Interfacial Properties of High Temperature Superconductors; (6) Semiconductor Laser Structures for Optical Interconnects; (7) Quantum Computing; and (8) Applications of SiGe in MOS Technologies. Information Systems: Packet Equalization, and Fast Arithmetic Computing with Neural Networks. GRA

N91-30423 Department of the Navy, Washington, DC.
DUAL DEMODULATING CIRCUIT TRACER Patent
Richard T. Nigon, inventor (to Navy), David P. Bochinski, inventor (to Navy), Roy H. Long, Jr., inventor (to Navy), and A. Kallio, inventor (to Navy) 5 Mar. 1991 9 p Filed 28 Mar. 90
(AD-D014941; US-Patent-4,998,059; US-Patent-Appl-SN-500337; US-Patent-Class-324-67) Avail: US Patent and Trademark Office CSCL 14/2

A non intrusive circuit tracer is described for positively identifying a conductor at position remote from a point of injection of a test signal. Tracer signal is alternately injected into two conductors at a rate of alternation which is substantially less than the tracer frequency. At another point along the conductor signal is sampled and synchronously demodulated first with respect to the tracer frequency and then with respect to the rate of alternation of the tracer frequency between conductors. GRA

N91-30424# Electronic Power Conditioning, Inc., Corvallis, OR.
DEVELOPMENT OF A VARIABLE-SPEED GENERATOR DRIVEN BY AN INTERNAL COMBUSTION ENGINE Final Report, Jun. 1989 - Dec. 1990
R. C. McArthur Apr. 1991 56 p
(Contract GRI-5088-293-1729)
(PB91-195875; GRI-91/0097) Avail: NTIS HC/MF A04 CSCL 09A

The development of a variable-speed generator driven by reciprocating engine is described. The operating speed range for the system is 1200 rpm to 3000 rpm. In that range the generator produces at its output 11 to 32 kW at high electrical potency. Less than 11 kW may be obtained by closing the throttle enough to produce the desired power level at 1200 rpm, but the more the throttle is closed the lower the electrical efficiency becomes. The engine-generator set uses a doubly-fed machine as the generator, a series-resonant converter to condition the power on the rotor windings, and a supervisory controller to execute the operating strategy and protection and diagnostics. It is a grid-connected system and can generate or consume reactive power on the stator windings of the generator. At synchronous speed the system is able to generate the same power as a fixed-speed system of the same rating. However, to reduce the output power it reduces the shaft speed instead of closing the throttle. The action maintains high electrical efficiency. The system is also able to operate above synchronous speed, which means it can produce more power than a fixed-speed system of the same rating. Author

N91-30425# Sandia National Labs., Albuquerque, NM.
PULSE POWER SWITCHING WITH LARGE VACUUM TRIODES
R. J. Adler and S. Humphries, Jr. (Acceleration Consultants, Albuquerque, NM.) 1991 8 p Presented at the 8th IEEE Pulsed Power Conference, San Diego, CA, 17-19 Jun. 1991
(Contract DE-AC04-76DP-00789)
(DE91-014671; SAND-91-7077C; CONF-910640-7) Avail: NTIS HC/MF A02

There are a variety of applications for pulse modulators which are capable of producing .5-10 kA at .1-1 MV. Some of these applications would be facilitated by a capability for multiple pulses. In this work, we have investigated the scaling of power triode technology into the range of interest described above. The specific application for this work is the extension of linear induction accelerator technology to very long pulse lengths without the requirement for heavy, costly magnetic cores. The development of a high power amplifier such as this one will also facilitate the development of RF accelerators of very high power and high power microwave sources. In this paper we first outline the requirements for the switch. We then outline the experimental apparatus, and then outline the results. DOE

N91-30426*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
MEASUREMENT TECHNIQUES FOR CRYOGENIC Ka-BAND MICROSTRIP ANTENNAS
M. A. Richard, K. B. Bhasin, C. Gilbert, S. Metzler, and P. C. Claspy (Case Western Reserve Univ., Cleveland, OH.) 1991 10 p Presented at the 13th Annual Meeting and Symposium of the Antenna Measurement Techniques Association, Boulder, CO, 7-11 Oct. 1991; sponsored by the National Inst. of Standards and Technology Sponsored in part by Ohio Aerospace Inst.

(Grant NGT-40016)
(NASA-TM-105183; E-6479; NAS 1.15:105183) Avail: NTIS HC/MF A02 CSCL 09C

The measurement of cryogenic antennas poses unique logistical problems since the antenna under test must be embedded in a cooling chamber. A method of measuring the performance of cryogenic microstrip antennas using a closed cycle gas cooled refrigerator in a far field range is described. Antenna patterns showing the performance of gold and superconducting Ka-band microstrip antennas at various temperatures are presented.
Author

N91-30427*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
MAKEUP AND USES OF A BASIC MAGNET LABORATORY FOR CHARACTERIZING HIGH-TEMPERATURE PERMANENT MAGNETS
Janis M. Niedra (Sverdrup Technology, Inc., Brook Park, OH.) and Gene E. Schwarze 1991 8 p Presented at the First International High Temperature Electronics Conference, Albuquerque, NM, 16-20 Jun. 1991; sponsored by Sandia National Laboratories, Wright Research and Development Center, and the Univ. of New Mexico
(NASA-TM-104508; E-6373; NAS 1.15:104508) Avail: NTIS HC/MF A02 CSCL 09A

A set of instrumentation for making basic magnetic measurements was assembled in order to characterize high intrinsic coercivity, rare earth permanent magnets with respect to short term demagnetization resistance and long term aging at temperatures up to 300 C. The major specialized components of this set consist of a 13 T peak field, capacitor discharge pulse magnetizer; a 10 in. pole size, variable gap electromagnet; a temperature controlled oven equipped with iron cobalt pole piece extensions and a removable paddle that carries the magnetization and field sensing coils; associated electronic integrators; and sensor standards for field intensity H and magnetic moment M calibration. A 1 cm cubic magnet sample, carried by the paddle, fits snugly between the pole piece extensions within the electrically heated aluminum oven, where fields up to 3.2 T can be applied by the electromagnet at temperatures up to 300 C. A sample set of demagnetization data for the high energy Sm2Co17 type of magnet is given for temperatures up to 300 C. These data are reduced to the temperature dependence of the M-H knee field and of the field for a given magnetic induction swing, and they are interpreted to show the limits of safe operation. Author

N91-30428 Quebec Univ., Varennes.
A STUDY OF ELECTROLYTES FOR LITHIUM BATTERIES Final Report, Oct. 1988 - Mar. 1989 [ETUDE DES ELECTROLYTES POUR LES ACCUMULATEURS AU LITHIUM]
Gerald Perron, J. E. Desnoyers, F. Rheault, R. Gagnon, F. Quirion, C. Camire, and J. Ledoux 12 May 1989 87 p In FRENCH; ENGLISH summary
(Contract DREO-W2207-6-AF37/01-ST)
(INRS-NRG-326-RF; CTN-91-60177) Avail: NTIS HC A05

The main objective of the work described here was to develop a fast and efficient method to optimize the electrolytic medium in primary and secondary high density Li/SO2 batteries over a wide range of temperatures. Mixed aprotic solvents are frequently used in batteries to optimize their performance. In the work described here, combinations of five solvents (acetonitrile, gamma butyrolacetone, 1,3- dimethoxyethane, 1,3- dioxolane and sulfolane), three electrolytes (LiBr, LiClO4, and LiAsF6), and SO2 were studied. The liquid-solid phase diagrams at 25 C were correlated with the viscosity, conductivity, density, and in some cases heat capacity of the mixture. Five types of material combinations were analyzed. These combinations included: (1) aprotic solvents + aprotic solvents, (2) electrolytes + aprotic solvents, (3) electrolytes + mixtures of aprotic solvents, (4) aprotic solvents + SO2, and (5) electrolytes + solvents + SO2. Mixed solvent plus electrolyte conductivities were up to 50 percent greater than the best conductivity observed when a single solvent was combined with an electrolyte. In addition the conductivity of the lithium salts in mixtures of aprotic solvents with SO2 at minus 15 C were measured. In this case, the specific conductivity maximized in the region corresponding to the SO2 rich eutectic for all mixtures studied. The study showed a correlation between the liquid solids equilibrium properties for the mixtures and their physico-chemical properties in solution, even at temperatures far above the solid liquid equilibrium point. CISTI

N91-30429 Department of National Defence, Ottawa (Ontario). Directorate Research and Development Air.
A MODERN APPROACH TO BATTERY TESTING: INFRARED THERMOGRAPHY AND VOLTAGE NOISE MEASUREMENTS
Gaston Verville, Pierre R. Roberge, Rejean Beaudoin, and John H. Smit (Ottawa Univ., Ontario) Nov. 1988 28 p Presented at the 9th International Electric Vehicle Symposium, Toronto, Ontario, 13-16 Nov. 1988
(CTN-91-60215) Avail: NTIS HC A03

Infrared thermography has been used to visualize the thermal characteristics of cells and batteries as a means of identifying defects and monitoring problems. A voltage electric noise measurement technique has recently attracted attention as a means to investigate voltage oscillations caused by minute changes in internal impedance of cells. The use of an infrared thermography system and voltage noise measurement to monitor voltage fluctuations in sealed lead acid batteries are described and compared. Infrared thermography was used as a rapid means to detect and monitor hot spots in sealed cells caused by internal short circuit formation and contact problems. It was unsuccessful in imaging batteries packed in a metal case. Investigation into the electromagnetic noise produced by batteries has lead to the identification of noise patterns for the discharge of healthy cells, those produced when recharging completely discharged cells, and those observed in low capacity cells during the charge cycle. Work is underway to define the origin of the noise and to assign noise signatures to some specific problems relating to sealed lead acid batteries. CISTI

N91-30430*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
LOW-LOSS COUPLING TO DIELECTRIC RESONATORS
C. P. Hearn, E. S. Bradshaw, R. J. Trew, and B. B. Hefner, Jr. (Analytical Services and Materials, Inc., Hampton, VA.) Jul. 1991 20 p
(NASA-TM-104111; NAS 1.15:104111) Avail: NTIS HC/MF A03 CSCL 09C

A compilation is presented of experimental observations and arguments concerning the use of dielectric resonators in applications requiring both tight coupling (beta greater than 10) and high unloaded Q, such as low loss bandpass filters. The microstrip coupled dielectric resonator is the primary focus, but an alternative coupling technique is discussed and comparatively evaluated. It is concluded that coupling factors as large as 65 are achievable. Author

N91-30431# European Space Agency, Paris (France).
PHYSICAL MECHANISMS AND DISTURBANCES RELATED TO THE ATTACHMENT OF AN ELECTRIC ARC TO A CONDUCTIVE CYLINDER Ph.D. Thesis - Paris VI Univ., 1988
Patrick Levesque (Office National d'Etudes et de Recherches Aerospatiales, Paris, France) May 1991 189 p Transl. into ENGLISH of Etude des Mecanismes Physiques Lies a l'Attachement d'un Arc Electrique sur un Cylindre Conducteur (Paris, France, ONERA), 1988 193 p Original language document was announced as N89-29698
(ESA-TT-1168; ONERA-NT-1988-2; ETN-91-99794) Avail: NTIS HC/MF A09

The physics of the interaction between medium length electric arcs (5 to 35 cm) and a structure simulating an aircraft fuselage on a small scale is discussed. The classical physical analysis of electrical discharges is recalled, and a certain number of typical discharge configurations in air, over short and long distances are described. The electrical characteristics of the experimental device are given and various electrical and optical diagnostic systems used are described. The main experimental results are given, along

with a critical analysis and a physical interpretation of the different phases of the phenomena. In particular, the special role of high current streamers and of the propagation of high conductivity leaders are revealed. An analysis of the correlations between the different phases of the arc-over and the voltages induced inside the simulated aircraft structure are given. ESA

N91-30432# Royal Aerospace Establishment, Farnborough (England).
EVOLUTION OF A VOLTAGE-TIME MODEL OF THERMAL BATTERIES
J. Knight 14 Feb. 1991 48 p
(RAE-TM-Mat/Str-1163; BR300873; ETN-91-99859) Copyright Avail: NTIS HC/MF A03

A temperature time model of thermal batteries has almost been completed and validated against experimental data. Early attempts to integrate a voltage time model into this, taking advantage of the instantaneous predictions of temperature, thermodynamic potentials, and internal resistance which the thermal model provides are described. Recent refinements of the voltage time model have led to improved simulation of the discharges of a wide range of sizes and types of thermal battery under an equally wide range of test conditions. The semi empirical approach adopted was to provide a universally applicable framework based on logical concepts to cover various effects such as polarization etc., but with adjustable numerical parameters. It is shown that a moderately good simulation may be obtained for the majority of available discharge curves, using this one set of equations and without altering parameter values. Further improvements can be obtained when parameter values are optimized for one particular type of battery. ESA

N91-30433# Royal Aircraft Establishment, Farnborough (England).
TEMPERATURE CONTROL IN THERMAL BATTERIES
V. N. Sheptunov, V. I. Kondratenkov, V. A. Korobov, and M. Yu. Nakhshin Mar. 1991 10 p Transl. into ENGLISH from Elektrotekh Prom-st Khim. Fiz. Istochniki (Toka, Japan), no. 2, 1981 p 13-15
(RAE-Lib-Trans-2192; BR302903) Avail: NTIS HC/MF A02

Methods of temperature control in thermal batteries are described. Different insulating materials are reviewed and the use of metal wraps round the cell stack to act as heat sinks is described. Salt mixtures which undergo phase changes at the operating temperatures of thermal batteries can be used as heat stores. Pyrotechnics with different burning speeds can be chosen to control the rate of heating of thermal batteries. Author

N91-30434# Royal Aircraft Establishment, Farnborough (England).
HEAT GENERATING COMPOSITIONS FOR THERMAL BATTERIES
V. N. Sheptunov Mar. 1991 12 p Transl. into ENGLISH from Elektrotekh Prom St Khim Fiz Istochniki (Toka, Japan), no. 5, 1983 p 16-19
(RAE-Lib-Trans-2191; BR302904) Avail: NTIS HC/MF A03

Thermal batteries are widely used as independent current sources with long storage life and the ability to operate over a wide ambient temperature range. A number of pyrotechnic materials may as rule be used as sources of thermal energy to provide ionic conduction in a molten electrolyte and to maintain the working temperature of the battery during the discharge of the electrochemical elements. The requirements for heat sources in thermal batteries are described and different heat generating compositions are reviewed. Author

N91-30435# Institut National Polytechnique, Grenoble (France). Lab. de Modelisation et Calcul.
NUMERICAL SIMULATION OF THE ELECTRIC ARC GAS FLOW INTERACTION IN MEAN AND HIGH VOLTAGE CIRCUIT BREAKERS Ph.D. Thesis [SIMULATION NUMERIQUE DE L'INTERACTION ARC ELECTRIQUE: ECOULEMENTS GAZEUX DANS LES DISJONCTEURS MOYENNE ET HAUTE TENSION]
Pierre Chevrier 1990 230 p In FRENCH
(ETN-91-99476) Avail: NTIS HC/MF A11

The flow gas with electric arc is simulated when the current is interrupted in a high or mean voltage circuit breaker. Compressible Navier-Stokes equations are solved for a nonviscous real gas. The electric arc is a nonconductor hot gas. Radiation is taken into account. State equation and gas properties are tabulated. An analysis of the physical problem and of equations to be solved is presented. Two unidimensional numerical modelizations were implemented, one by finite element method, the other by a fractional step method separating the treatment of diffusion and convection phenomena. They allowed the model to be improved and the importance of radiation to be outlined. A two dimensional plane or axisymmetrical industrial calculation code is developed, which allows the problem on nonstructural and mobile meshings to be solved. ESA

N91-30436# Institut National Polytechnique, Grenoble (France). Techniques de l'Information, des Mathematiques, de la Microelectronique et de la Microscopie.
FAILURE ANALYSIS OF VLSI INTEGRATED CIRCUITS BY ELECTRON BEAM TESTER Ph.D. Thesis [ANALYSE DE DEFAILLANCES DE CIRCUITS INTEGRES VLSI PAR TESTEUR A FAISCEAU D'ELECTRONS]
Denis Savart 1990 183 p In FRENCH; ENGLISH summary
(ETN-91-99477) Avail: NTIS HC/MF A09

Automatic fault localization on unknown circuits, using an electron beam tester, is dealt with. The point of view of the analyst is described. Contactless techniques and electron beam testing are to be chosen. The method used to locate a failure inside a VLSI (Very Large Scale Integration) integrated circuit is described by comparing the failed circuit potential contrast image with the image of a golden device. Automation problems are analyzed and solutions proposed. Image processing algorithms are described. Experimental phases on two different test equipments are reported. The practicality and reliability of the comparison method are shown. The necessity to work out high level tools on electron beam tester computer is outlined. ESA

N91-30437# Institut National Polytechnique, Grenoble (France). Techniques de l'Information, des Mathematiques, de la Microelectronique et de la Microscopie.
A FEASIBILITY STUDY OF A HIGH-SAFETY MICROCONTROLLER Ph.D. Thesis
Gilles Chaumontet 1990 191 p In FRENCH; ENGLISH summary
(ETN-91-99480) Avail: NTIS HC/MF A09

A MAPS microcontroller was designed for railway signalling, using an online and offline self test integrated logic circuit, in conformity with the Unified Built In Self Test (UBIST) technique. An output port is fitted to MAPS, in order to produce failsafe frequency modulated drive signals. An interface is used, which is designed for only accepting external signals which have been recast into a failsafe format. These two interfaces were integrated on the same chip as the self checking circuit, and are strongly failsafe. A new approach to the design of highly critical systems is given, yielding at the same time a higher safety factor than the one given by present systems for less bulk and lower cost. ESA

N91-30438# Institut National Polytechnique, Grenoble (France). Lab. de Genie Informatique.
FUNCTIONAL TEST GENERATION FOR DIGITAL CIRCUITS DESCRIBED WITH A DECLARATIVE LANGUAGE: LUSTRE Ph.D. Thesis [GENERATION DE TEST FONCTIONNEL DE CIRCUITS DIGITAUX DECRITS AVEC UN LANGAGE DECLARATIF: LUSTRE]
Mazen AlMahrous 1990 215 p In FRENCH; ENGLISH summary
(ETN-91-99481) Avail: NTIS HC/MF A10

A functional approach to the test generation problem starting from a high level description is proposed. The circuit tested is modeled, using the LUSTRE high level data flow description

language. The different LUSTRE primitives are translated to a SATAN format graph in order to evaluate the testability of the circuit and to generate test sequences. Another method of testing the complex circuits comprising an operative part and a control part is defined. It consists of checking experiments for the control part observed through the operative part. It was applied to the automata generated from a LUSTRE description of the circuit. ESA

N91-30439# Nationaal Inst. voor Kernfysica en Hoge Energiefysica, Amsterdam (Netherlands).
REQUIRED ACCURACY OF TUNE MEASUREMENT AND PARAMETRIZATION OF CHROMATICITY CONTROL
R. Maas Feb. 1991 5 p
(NIKHEF-K/AmPS/91-05; ETN-91-99526) Avail: NTIS HC/MF A01

The betatron tunes upsilon(x) and upsilon(y) are measured by Fourier analyzing a BPM signal generated by a beam which received a fast (less than 600 ns) kick. Alternatively, the tune can be measured by applying a (sinusoidal) signal of varying frequency to a pair of deflectors; if the fractional part of f(kick)/f(rev) equals the fractional part of the tune, a beam blowup can be observed. The required accuracy of such a tune measurement is discussed. ESA

N91-30440# European Space Research Organization, Noordwikj (Netherlands). Product Assurance and Safety Dept.
CAPABILITY APPROVAL PROGRAMME FOR HERMETIC THIN-FILM HYBRID MICROCIRCUITS
May 1990 62 p
(ESA-PSS-01-605-Issue-1; ISSN-0379-4059; ETN-91-99529)
Copyright Avail: NTIS HC/MF A04

The general requirements for capability approval of a manufacturing line for hermetic thin film hybrid microcircuits are defined. The evaluation and capability approval testing phases and maintenance, suspension and withdrawal of capability approval are covered. Before evaluation can commence, the manufacturer shall define the capability approval domain by specifying the processes, materials and techniques involved in the technology for which approval is sought. ESA

N91-30242*# Communications Satellite Corp., Clarksburg, MD.
A I-V ANALYSIS OF IRRADIATED GALLIUM ARSENIDE SOLAR CELLS
A. Heulenberg, R. H. Maurer, and J. D. Kinnison (Johns Hopkins Univ., Laurel, MD.) *In* NASA. Lewis Research Center, Space Photovoltaic Research and Technology Conference Aug. 1991 6 p Sponsored in part by NASA, and by Communications Satellite Corp. (For primary document see N91-30203 22-20)
Avail: NTIS HC/MF A20 CSCL 09C

34 FLUID MECHANICS AND HEAT TRANSFER

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics.*

N91-30441# Washington Univ., Seattle. Dept. of Aeronautics and Astronautics.
TURBULENT MIXING IN EXPONENTIAL TRANSVERSE JETS Final Report, 1 Aug. 1988 - 31 Jul. 1990
Robert E. Breidenthal 30 Sep. 1990 15 p
(Grant AF-AFOSR-0366-87)
(AD-A229435; AFOSR-90-1119TR) Avail: NTIS HC/MF A03 CSCL 20/4

The effects of acceleration on vortex growth and molecular mixing have been systematically explored for the first time in a transverse array of exponentially increasing jets. The issue is the influence of a new kind of forcing which imposes on a vortex a time scale from an exponential rather than a sinusoidal wave. The results are that such forcing dramatically reduces the normalized size of the vortex. Therefore the capacity for mixed fluid inside the vortex is also reduced, by about a factor of eight at large acceleration. GRA

N91-30442# Cambridge Univ. (England).
PROCEEDINGS OF THE 11TH SYMPOSIUM ON GAS KINETICS
7 Sep. 1990 276 p Symposium held in Perugia, Italy, 2-7 Sep. 1990
(Contract DAJA45-90-M-0186)
(AD-A229490; R/D-6445-CH-02) Avail: NTIS HC/MF A13 CSCL 20/4

This book, prepared by F. Vecchiocattivi and F. Pirani, contains the abstracts of the papers (invited talks, oral presentations, poster contributions) presented at the Eleventh International Symposium on Gas Kinetics. The Symposium is held at La Cittadella, Assisi, Italy, organized by the Gas Kinetics Group of the Royal Society of Chemistry, London, and the Molecular Beams and dynamics Group of the Department of Chemistry of the University of Perugia. The programme includes contributions on new, as well as traditional, themes in Gas Phase Kinetics. Highlighted topics include: (1) Atmospheric Chemistry; (2) Theory of Reactive, Inelastic, and Photodissociative Processes; (3) Combustion Chemistry; (4) Elementary Reactions of Neutral and Ionic Species; E) Reaction Dynamics and State-to-State Chemistry; (5) Photodissociation Dynamics; (6) Gas-Surface Interactions. GRA

N91-30443# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Aerospace and Ocean Engineering.
MEASUREMENTS OF SURFACE SHEAR STRESSES UNDER A THREE-DIMENSIONAL TURBULENT BOUNDARY LAYER USING OIL-FILM LASER INTERFEROMETRY Technical Report, 1 Dec. 1988 - 30 Nov. 1989
K. G. Ailinger and R. L. Simpson 1 Apr. 1990 129 p
(Contract N00014-89-J-1275)
(AD-A229494; VPI-AOE-173) Avail: NTIS HC/MF A07 CSCL 20/4

Measurements of surface shear stress magnitude and direction are reported for a three-dimensional, pressure driven, turbulent boundary layer around a wing body junction. Measurements were made using a dual-beam oil film laser interferometer at 56 locations. An iterative procedure was developed which increased the precision of the data extracted from the data records. Skin friction directions computed using a least square error fit were compared to angles obtained from surface oil flows, hot wire anemometry, and LDV measurements. Also, the magnitude of the skin friction coefficients were compared to independently obtained skin friction coefficients. The data agreed to within experimental error outside the effects from the vortex legs present along the side of the wing-body. No accurate data was available for quantitative comparison under the effects of the vortex, but the magnitudes followed the qualitative trends expected. This method failed badly in the region of large three-dimensional effects and requires further study in this area of application. GRA

N91-30444# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Aerospace and Ocean Engineering.
STUDY OF THREE-DIMENSIONAL PRESSURE-DRIVEN TURBULENT BOUNDARY LAYER Technical Report, 1 Dec. 1988 - 31 Aug. 1990
Semih M. Olcmen and R. L. Simpson 31 Aug. 1990 499 p
(Contracts N00014-89-J-1275; N00014-90-J-1909)
(AD-A229495; VPI-AOE-178) Avail: NTIS HC/MF A21 CSCL 01/1

A three dimensional, pressure driven turbulent boundary layer created by an idealized wing-body junction flow is experimentally studied. The body used is a 3:2 elliptical nosed NACA 0020 tailed symmetric profile which has a chord length of 30.5 cm (12 in.), maximum thickness of 7.17 cm (2.824 in.), height of 22.9 cm (9.016 in.). The body was sitting on a flat plate. The nominal reference velocity of the flow is 27 m/sec and the Reynolds number based on the momentum thickness at 0.75 chord upstream of the

body on the centerline of the tunnel is approximately 5936. The data presented include time-mean static pressure, skin friction magnitude and direction on the wall, as well as the mean velocity and all Reynolds stresses at several stations on a line determined with the mean velocity vector component parallel to th wall in the layer where the normal stress is maximum. The mean velocity and stress data were obtained both with hot-wire (HW) and laser-Doppler-velocimeter (LDV) techniques. The LDV measurement were taken twice due to the differences observed between the HW and LDV data, which is also shown with the present study. This gave a chance to study the uncertainties on the mean velocity and the stresses extensively. Pressure distributions on the wing and the on on the bottom plate were obtained with a Scanivalve and an inclined manometer. GRA

N91-30445 Stanford Univ., CA.
EMISSION AND LASER-INDUCED FLUORESCENCE DIAGNOSTICS OF A SUPERSONIC JET OF PLASMA-HEATED NITROGEN Ph.D. Thesis
Lawrence Mark Cohen 1991 163 p
Avail: Univ. Microfilms Order No. DA9115754

A facility was constructed for studying supersonic flows of partially ionized gases. The facility uses an inductively-coupled radio frequency (RF) plasma torch to increase the stagnation temperature of nitrogen to approximately 4700 K. The gas then flows through a converging nozzle and exhausts into a water-cooled test section as an underexpanded, supersonic jet. With moderate pressure ratios across the nozzle (around 5), flow velocities of up to 2500 m/sec were generated in the resulting flowfield. Dissert. Abstr.

N91-30446 Stanford Univ., CA.
QUANTITATIVE IMAGING OF TURBULENT GASEOUS JETS USING PLANAR LASER-INDUCED FLUORESCENCE Ph.D. Thesis
Ike John VanCruyningen 1991 132 p
Avail: Univ. Microfilms Order No. DA9115860

The Planar Laser-Induced Fluorescence (PLIF) technique was used to instantaneously and non-intrusively acquire quantitative images of species concentration in gaseous jet flows. The quantitative aspects of the technique are investigated in detail, then computer rendering techniques are utilized to interpret the images and finally statistical methods are used to process turbulent jet images to yield insights into turbulent mixing and jet spatial structure. Dissert. Abstr.

N91-30447 New Mexico Inst. of Mining and Technology, Socorro.
DETONATION SHOCK DYNAMICS OF COMPOSITE ENERGETIC MATERIALS Ph.D. Thesis
Jaimin Lee 1990 175 p
Avail: Univ. Microfilms Order No. DA9115700

A reaction-rate equation for a composite energetic material was calibrated from two-dimensional steady-state experiment data by using the detonation shock dynamics theory. From experimental detonation velocities and shock-front shapes at different diameters for an ammonium nitrate-based emulsion explosive at 1.248 g/cu cm, the relationship between the detonation velocity normal to the shock-front and the shock-front curvature was obtained. By using this relationship and solving the quasi one-dimensional Euler equations of motion in a problem-conforming intrinsic-coordinate frame obtained from the detonation shock dynamics theory, the reaction rate was determined as a function of pressure and density. The reaction-rate equation obtained for this emulsion explosive shows that the rate is very slow and weakly state dependent. These characteristics of the rate indicated that the nonideal behavior of most industrial-type explosives can be attributed to their slow and state-insensitive rates. By using rate equation, one-dimensional initiation experiments (wedge tests) were numerically modeled with a one-dimensional Lagrangian hydrodynamic code. The calculated shock trajectories agreed very well with experimental wedge test data. This agreement also suggested that the small shock-curvature asymptotics may be valid even for a relatively large value of the curvature. The calibration method developed in this study is independent of the form of the rate. Realistic rate equations for explosives can be obtained in a very systematic way from two-dimensional steady-state experiments. Dissert. Abstr.

N91-30448 Illinois Univ. at Urbana-Champaign, Savoy.
PARTICLE DISPERSION IN ISOTROPIC TURBULENCE AND UNSTEADY PARTICLE DYNAMICS AT FINITE REYNOLDS NUMBER Ph.D. Thesis
Renwei Mei 1990 341 p
Avail: Univ. Microfilms Order No. DA9114344

A solution to particle dispersion in an isotropic turbulence under Stokes drag, Basset force and gravitational force is obtained in closed form using the independence approximation. The Basset force has no affect on the fluid velocity structure seen by the particles or the long-time particle diffusivities. It does affect the intensities of particle motion for particles with large settling rate and with response time comparable to the turbulence integral time scale. A solution for particle dispersion in isotropic turbulence with non-Stokesian drag and gravitational force is obtained. The time constants of the particle fluctuation in the directions parallel and perpendicular to the gravity are anisotropic. Turbulence increases particle response time constants and reduces settling velocity. Influence of the nonlinear drag, particle response time constants and settling rate on particle dispersion are investigated. Monte-Carlo simulations are performed for particle motions in an isotropic turbulence with non-Stokesian drag. Pseudo-turbulence is generated using random Fourier modes representation. Statistical averages are obtained from more than 5000 particles. The results of the simulation validate the preceeding analysis in the non-Stokesian drag range. The influence of turbulence structure on the dispersions of fluid and particle is examined. In addition to the integral length and time scales, the functional form of the energy spectrum is also important in describing the dispersions of both fluid and particles. Dissert. Abstr.

N91-30449 Virginia Polytechnic Inst. and State Univ., Blacksburg.
SECONDARY INSTABILITIES OF BOUNDARY LAYERS Ph.D. Thesis
Jamal Ahmad Masad 1990 259 p
Avail: Univ. Microfilms Order No. DA9116637

Several aspects of the subharmonic instability of boundary layers are studied. First, the subharmonic instability of incompressible flows over a flat plate is investigated using the resonant triad model and the Floquet model. The primary wave is taken in the form of a two-dimensional (2-D) Tollmien-Schlichting (T-S) wave. The subharmonic wave is taken in the form of a three-dimensional (3-D) wave. Results from both models are presented and compared with the experimental data and numerical simulation. Second, the subharmonic instability of incompressible flows over a 2-D hump is studied using the Floquet model. The mean flow over the hump is calculated by using interacting boundary layers, thereby accounting for viscid/inviscid interations. Third, the subharmonic instability of compressible boundary layers over a flat plate is studied using the Floquet model. Results are presented for adiabatic wall boundary conditions and subsonic, transonic, and supersonic flows. The effect of Mach number, spanwise wavenumber, primary-wave amplitude, Reynolds number, and frequency are studied. Fourth, results for the effect of heat transfer on the subharmonic instability of a two-dimensional compressible boundary layer over a flat plate are presented for different Mach numbers. The effect of different levels of heat transfer on changing the features of the subharmonic compressible instability is evaluated. Fifth, results for the effect of suction on the subharmonic instability of a two-dimensional compressible boundary layer over a flat plate are presented. Sixth, the effect of a bulge on the subharmonic instability of compressible boundary layers is studied. Dissert. Abstr.

N91-30450 Southampton Univ. (England).
PARTICLE IMAGE VELOCIMETRY: DATA REDUCTION USING OPTICAL CORRELATION Ph.D. Thesis
Jeremy Michael Coupland 1990 190 p
Avail: Univ. Microfilms Order No. BRDX92256

Fundamental research into a new measurement technique in fluid dynamics called particle image velocimetry (PIV) is presented. This non-intrusive technique provides a means of mapping instantaneous flow fields in unsteady fluid flows. In its simplest form, PIV uses double exposure photography to record the position of seeding particles found within a thin light sheet illuminating a section from the flow of interest. Analysis of the resulting transparency involves multiple point measurement of the displacement associated with random patterns of particle images. If the time interval between the exposures and the magnification of the recording optics are known then these displacement measurements can be related to the fluid velocity and a two-dimensional flow map can be constructed. As a simple and cost effective solution to the problem of PIV transparency analysis, optical methods which perform rapid calculation of two-dimensional spatial autocorrelation, are discussed. Both incoherent and coherent techniques are considered and the performance of each examined with reference to PIV data reduction. A fully automated transparency analysis system, based on a new design of optical autocorrelator, is described and applied to the study of several flows of varying complexity. In a theoretical treatment, the choice of experimental parameters, such as the size of seeding particles, is related to the type of velocity field which can be examined in this way. Having developed a basis for PIV system design, the practical problems associated with photographing the fluid flow are investigated and a versatile and inexpensive light source based on a linear Xenon flashlamp is described for this purpose. Finally, a combination of alternative methods to record the light scattered by the seeding particles with optical correlation analysis are examined. Methods to overcome the 180 degree ambiguity inherent in conventional photographic recordings and the extension of PIV for the whole field, three-dimensional measurement of fluid velocity fields are discussed. Dissert. Abstr.

N91-30451 Michigan Univ., Ann Arbor.
THE INFLUENCE OF A FREE SURFACE ON THE DEVELOPMENT OF TURBULENCE IN A SUBMERGED JET Ph.D. Thesis
Douglas George Anthony 1990 162 p
Avail: Univ. Microfilms Order No. DA9116112

Radar images of the ocean surface made when surface ships are moving within the imaged area reveal distinctive surface signatures attributed to the interaction of the turbulent wake of the ship with the free surface. In order to study the behavior of turbulence near a free surface, the flow in a round, turbulent jet issuing beneath and parallel to a clean free surface was investigated experimentally. A three-component Laser Doppler Velocimeter (LDV) was used to make detailed measurements of the mean flow velocity and Reynolds stress tensor throughout the flowfield. Surface shadowgraphs and Laser Induced Fluorescence (LIF) were used to visualize features of the free surface deformations and the subsurface flowfield. The LDV measurements revealed that near the jet centerline, the RMS velocity fluctuations become anisotropic as the free surface is approached. The fluctuations normal to the surface are diminished, while those parallel to the surface are enhanced. Measurements made near the surface on either side of the jet revealed the existence of a shallow surface current much wider than the primary jet flow. Within this current, the magnitudes of the cross-stream and vertical RMS velocity fluctuations are approximately the same, but are greater than that of the streamwise fluctuations. This is attributed to motions arising from surface waves propagating perpendicular to the jet axis and superposed on the surface current. LIF images of the surface current show it to consist largely of fluid emitted from the jet. Beneath a clean free surface, these emissions propagate to considerable distance under the influence of their images above the surface. When a surfactant is placed onto the water surface, vortical fluid ejected from the jet interacts with secondary vorticity generated beneath the surfactant covered surface, and the surface current is suppressed. Dissert. Abstr.

N91-30452 Pennsylvania State Univ., University Park.
WEAKLY NONLINEAR MODELS FOR TURBULENT FREE SHEAR FLOWS Ph.D. Thesis
William Whai-Wai Liou 1990 169 p
Avail: Univ. Microfilms Order No. DA9117713

A weakly nonlinear theory is developed to provide closure models for turbulent free shear flows with a minimum of empiricism. The theory uses an instability wave description of the dominant large-scale structures in these flows. The local characteristics of these structures are described using linear inviscid theory. The amplitudes of the large-scale turbulent fluctuations are determined from an energy integral analysis. As an exploratory evaluation of the present weakly nonlinear theory, three models are developed to study the structural dynamics of the turbulent motions of different scales in free mixing layers. Model 1 considers the turbulent fluctuations of both large and small scales and contains two model constants. Model 2 neglects the effects of small scales on the development of mean flow and contains only one model constant. The first two models describe an ensemble of many realizations of the large-scale structures. Model 3 simulates the unsteady aerodynamics of the mixing layers associated with a single realization of the passage of a train of large-scale structures. Model 3 contains no model constraints. In all the models, predictions are made for the axial development and the distributions of the mean flow of the turbulent free mixing layer. These include the shear layer growth rates, the mean velocity profiles and the Reynolds stresses. In the last model, predictions of the time dependent behavior of the layer at the large scale are made. The predictions show good agreement with experiments. It is hoped that this weakly nonlinear theory that originates from observed physical phenomena will provide efficient tools for the modeling of other turbulent free shear flows. Dissert. Abstr.

N91-30453 Clarkson Univ., Potsdam, NY.
NUMERICAL AND EXPERIMENTAL INVESTIGATION OF PARTICLE TRANSPORT AND DEPOSITION IN TURBULENT FLOWS Ph.D. Thesis
Salem Oudeh Abuzeid 1991 189 p
Avail: Univ. Microfilms Order No. DA9117610

A numerical and experimental investigation of the transport and deposition of submicron particles in turbulent channel and stagnation-point flow situations is presented. Diffusion of small suspended particles in a 2-D turbulent channel flow is studied by solving the transport advection-diffusion equation. Deposition velocity is evaluated at different sections in the channel for different particle sizes and flow Reynolds numbers. Motion of small suspended particles in a turbulent channel flow are studied. Trajectories of aerosol particles in the channel are evaluated by solving the corresponding Lagrangian equation of motion that includes effects of Brownian motion and turbulence fluctuations. Simulations are carried out for aerosol particles released at different locations across the channel. Depositions of particles on the channel wall for several flow Reynolds numbers and different inlet turbulence intensity are evaluated. Particle deposition in 2-D laminar and turbulent stagnation-point flow is numerically simulated. Using the Lagrangian approach, deposition of particles on the wall is evaluated and a capture area which varies with particle sizes is produced. The effect of the fluid on particle deposition rate using Lagrangian and Eulerian approaches is predicted (for air and water). The effects of electrostatic force on particle capture area (deposition rate) is shown. Different surface voltages of 0.0, 1.0, and 4.0 kV/cm are considered. An experimental study was performed to measure the rate of deposition of submicron particles on a silicon wafer within an actual cleanroom environment. Particle diameter ranging from 0.1-1.0 microns were tested. The effect of particle diameter and air ionization on particle deposition is also shown. The results of the investigation are presented.
Dissert. Abstr.

N91-30454 Stanford Univ., CA.
HEAT TRANSFER WITH HIGH INTENSITY, LARGE SCALE TURBULENCE: THE FLAT PLATE TURBULENT BOUNDARY LAYER AND THE CYLINDRICAL STAGNATION POINT Ph.D. Thesis
Forrest Edward Ames 1991 250 p
Avail: Univ. Microfilms Order No. DA9115734

The influence of high intensity, large scale turbulence on heat transfer from the zero velocity gradient turbulent boundary layer and the cylindrical stagnation region is examined. This research is relevant to the development of gas turbine engines where high levels of turbulence exist and are believed to be responsible for large uncertainties in assessing gas path heat transfer. High intensity, large scale turbulence was generated in a simulated combustor. Turbulence levels of up to 19 percent were reached. Heat transfer from a flat plate turbulent boundary layer was determined using three constant temperature cylinders with a 4 to 1 diameter range. Baseline tests demonstrate the ability to determine local flat plate heat transfer within +/- 2.5 percent, and cylindrical region heat transfer within +/- 4 percent. Hot wire anemometry using a single wire was used to survey the velocity and turbulence distributions as well as to take velocity-time records in order to characterize the longitudinal integral and energy scales of the flow. An orthogonal axis triple wire was used to survey the mean and fluctuating velocities in the X,Y, and Z directions. The thermal boundary layer was examined using a thermocouple probe. An outer layer eddy diffusivity model was developed for use in the STAN7 finite difference boundary layer code, which predicts the heat transfer results within +/- 5 percent. A correlating parameter was developed which collects the present data within +/- 3 percent. Dissert. Abstr.

N91-30455 Stanford Univ., CA.
STRUCTURE AND CONTROL OF A PARTICLE-LADEN JET Ph.D. Thesis
Ellen Kathryn Longmire 1991 243 p
Avail: Univ. Microfilms Order No. DA9115810

The interaction of solid particles with the temporal features of a turbulent flow has direct relevance to problems such as particle and spray combustion and the processing of particulate solids. The objective of the present study was to examine the behavior of particles in a jet dominated by vortex ring structures. An axisymmetric air jet laden with 55 micron glass particles was forced axially with an acoustic speaker to organize the vortex ring structures rolling up in the free shear layer downstream of the nozzle exit. Visualization studies of forced and unforced flow with Reynolds number on the order of 20,000 were completed using a pulsed copper vapor laser. Instantaneous photographs and videotapes of strobed forced flow show that particles are clustered in saddle regions downstream of the vortex rings and propelled away from the jet axis by the outwardly moving flow in these regions. Phase-averaged spatial distributions of particle number density computed from digitized photographs and phase-averaged particle velocity measurements yield further evidence that particle dispersion is governed not by diffusion but by convection due to large-scale turbulence structures. Dissert. Abstr.

N91-30456 Stanford Univ., CA.
SIMULATION OF A COMPRESSIBLE FORCED MIXING LAYER USING CLEBSCH'S VARIABLES Ph.D. Thesis
Yehuda Shiran 1991 294 p
Avail: Univ. Microfilms Order No. DA9115846

A new finite difference scheme which uses Clebsch's variables to stimulate inviscid compressible flow is described. It is known that if the velocity field can be computed from a potential, Euler's equations can be integrated to yield Bernoulli's equation, but only if the flow is irrotational or the flow is steady rotational and the integration is carried along a streamline. The authors show how Clebsch's three-potential representation facilitates the integration of Euler's equations along an arbitrary path in a rotational flow. The code is faster per time step than other second-order accurate schemes. The second advantage of the scheme is its particle tracking capability. The authors used the code to investigate the forced mixing layer. A new correlation was found between the layer growth rate and the amplification from the linear theory for all spatial Strouhal numbers. Other works found a correlation between the growth rate and the maximum amplification at a specific Strouhal number. The authors' correlation explains the effect of the Reynolds number, the amplitude, the forcing frequency, and the Mach number on the layer's behavior. It explains the puzzling result of higher growth rates when the forcing frequency is smaller than the most amplified one from the linear theory, and the lower growth rates when the forcing frequency is higher than the most amplified one. They found that results from different experiments and simulations can be collapsed onto a common representation, the St sub alpha - T space. The spatial Strouhal number St sub alpha ranges between zero and one, and the non-dimensional time T ranges between zero and one for the first region of the development, and between one and two for the second region. Dissert. Abstr.

N91-30457 Michigan Univ., Ann Arbor.
NUMERICAL SIMULATIONS OF MULTIFLUID FLOWS Ph.D. Thesis
Salih Ozen Unverdi 1990 123 p
Avail: Univ. Microfilms Order No. DA9116314

A method for full numerical simulations of unsteady, incompressible Navier-Stokes equations for multi-fluid systems is developed. Moving interfaces between dissimilar fluids are explicitly tracked and fluid properties are constructed on a stationary grid using the position of the interfaces. While the interfaces are explicitly tracked, they are not kept completely sharp but are given a finite thickness of the order of the mesh size to provide stability and smoothness. This thickness remains constant for all time but decreases with finer resolution of the stationary grid. A unique feature of the method is that the tracked interfaces carry the jump in properties across the interface and that, at each time step, the property fields are reconstructed by solving a Poisson equation. The advantage of this approach is that interfaces can interact in a natural way, since the gradients add or cancel as the grid distribution is constructed from the information carried by the tracked front. The emphasis is on the shape regimes of bubbles and bubble-bubble interactions in a stationary fluid. The circular, elliptical and skirted shape regimes and wake structures of two-dimensional bubbles are studied. Three-dimensional evolution of the interaction of two bubbles in a stationary fluid is investigated. Interaction of bubbles in a periodic array is also studied and it is found that a pair of bubbles in a free rise can interact in the absence of a toroidal wake below the upper bubble and that the interaction time is smaller as the viscosity of the outer fluid decreases. It is shown that the kinetic energy of the flow field decreases during this interaction. Sensitivity of the bubble interaction process to fluid properties is shown by different trajectories followed by bubbles in fluids of different viscosity. The Rayleigh-Taylor instability is also studied. Dissert. Abstr.

N91-30458 Washington State Univ., Pullman.
ON THE DISPERSION OF HEAVY PARTICLES BY TURBULENT MOTION Ph.D. Thesis
Lian-Ping Wang 1990 249 p
Avail: Univ. Microfilms Order No. DA9116590

Theoretical analysis, numerical simulations, and experimental measurements were used to understand the dispersion of heavy particles. The analysis provided a solution for dispersion statistics in terms of measurable fluid Eulerian statistics, particle Stokes number, and particle drift parameter. Heavy particles can disperse faster than fluid elements if the Stokes number controls the dispersion and slower than fluid elements if the Stokes number controls the dispersion and slower than fluid elements if the drift parameter governs the dispersion. This finding explained previous contradictory dispersion data observed in experimental measurements. Not only the particle time scale but also the particle velocity scale in the direction normal to the drift were shown to be less than their respective values in the direction parallel to the drift due to a coupled effect of drift velocity and fluid continuity. Use of nonlinear drag was made possible in the analysis by

introducing an effective inertia and an effective drift. The anisotropy of both the particle velocity scale and the time scale was experimentally measured. The results of the investigation are presented. Dissert. Abstr.

N91-30459*# George Washington Univ., Washington, DC. School of Engineering and Applied Science.
INVESTIGATION OF THERMAL-FLUID MECHANICAL CHARACTERISTICS OF THE CAPILLARY PUMP LOOP Final Technical Report
Ali M. Kiper Aug. 1991 81 p
(Grant NAG5-834)
(NASA-CR-188730; NAS 1.26:188730) Avail: NTIS HC/MF A05 CSCL 20D

The main purpose is the experimental and analytical study of behavior of the Capillary Pump Loop (CPL) heat pipe system during the transient mode of operating by applying a step heat pulse to one or more evaporators. Prediction of the CPL behavior when subjected to pulse heat loading requires further study before the transient response of CPL system can be fully understood. The following tasks are discussed: (1) exploratory testing of a CPL heat pipe for transient operational conditions which could generate the type of oscillatory inlet temperature behavior observed in an earlier testing of NASA/GSFC CPL-2 heat pipe system; (2) analytical investigation of the CPL inlet section temperature oscillations; (3) design, construction and testing of a bench-top CPL test system for study of the CPL transient operation; and (4) transient analysis of a CPL heat pipe by applying a step power input to the evaporators. Author

N91-30460# Maryland Univ., College Park. Dept. of Mathematics.
NONLINEAR WAVES IN MECHANICS AND GAS DYNAMICS Final Report, 1 Jun. 1987 - 30 Sep. 1990
Tai-Ping Liu 21 Dec. 1990 8 p
(Contract DAAL03-87-K-0063)
(AD-A238340; ARO-23946.4-MA) Avail: NTIS HC/MF A02 CSCL 20/13

Nonlinear hyperbolic-parabolic partial differential equations which are related to gas dynamics and mechanics were studied. Hyperbolic conservation laws with relaxation are studied with applications to kinetic theory, elasticity with memory and gas flow with thermo-non-equilibrium in mind. Nonlinear waves for the compressible Navier-Stokes equations are studied for their stability and time-asymptotic behavior. The singular behavior of the magnetohydrodynamics shock waves in the small dissipation limits is clarified, in particular, it is shown that intermediate shocks are stable uniformly with regards to the strength of dissipations only for 2-D model, and not for 3-D model. GRA

N91-30461*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
RELATIONSHIP OF OPTICAL COATING ON THERMAL RADIATION CHARACTERISTICS OF NONISOTHERMAL CYLINDRICAL ENCLOSURES
Joseph F. Baumeister Aug. 1991 20 p
(NASA-TM-104408; E-6234; NAS 1.15:104408) Avail: NTIS HC/MF A03 CSCL 20D

A numerical ray tracing technique was applied to simulate radiation propagating from various non-isothermal cylindrical cavities to determine the effect of optical coating (surface emissivity). In general, the analysis showed that the optical coating and temperature within a cavity have a significant effect on emitted radiation based on cavity dimension. Temperature thresholds were found to exist where the same optical coating may either reduce or increase cavity performance (apparent emissivity). Parametric values of apparent emissivity results are presented over a wide range of variables to correlate cylindrical cavity radiation for non-uniform cavity emissivity values. A universal curve was developed to aid in selecting wall emissivity values for design considerations. Author

N91-30462*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
VERIFICATION OF THE PROTEUS TWO-DIMENSIONAL NAVIER-STOKES CODE FOR FLAT PLATE AND PIPE FLOWS
Julianne M. Conley and Patrick L. Zeman (Arnold Engineering Development Center, Arnold Air Force Station, TN.) 1991 9 p Presented at the 27th Joint Propulsion Conference, Sacramento, CA, 24-27 Jun. 1991; sponsored by AIAA, SAE, ASME, and ASEE Previously announced as A91-41678
(NASA-TM-105160; E-6449; NAS 1.15:105160; AIAA-91-2013)
Avail: NTIS HC/MF A02 CSCL 20D

The Proteus Navier-Stokes Code is evaluated for 2-D/axisymmetric, viscous, incompressible, internal, and external flows. The particular cases to be discussed are laminar and turbulent flows over a flat plate, laminar and turbulent developing pipe flows, and turbulent pipe flow with swirl. Results are compared with exact solutions, empirical correlations, and experimental data. A detailed description of the code set-up, including boundary conditions, initial conditions, grid size, and grid packing is given for each case. Author

N91-30463# Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental and Hazardous Material Studies.
MOFAT: A TWO-DIMENSIONAL FINITE ELEMENT PROGRAM FOR MULTIPHASE FLOW AND MULTICOMPONENT TRANSPORT. PROGRAM DOCUMENTATION AND USER'S GUIDE
A. K. Katyal, J. J. Kaluarachchi, and J. C. Parker May 1991 119 p Sponsored in part by EPA, Ada, OK
(PB91-191692; EPA/600/2-91/020) Avail: NTIS HC/MF A06 CSCL 20D

The manual describes a two-dimensional finite element model for coupled multiphase flow and multicomponent transport in planar or radially symmetric vertical sections. Flow and transport of three fluid phases, including water, nonaqueous phase liquid (NAPL), and gas are considered by the program. The program can simulate flow only or coupled flow and transport. The flow module can be used to analyze two phases, water and NAPL, with the gas phase held at constant pressure, or explicit three-phase flow of water, NAPL, and gas at various pressures. The transport module can handle up to five components which partition among water, NAPL, gas and solid phases assuming either local equilibrium or first-order mass transfer. Three phase permeability-saturation-capillary pressure relations are defined by an extension of the van Genuchten model. The governing equations are solved using an efficient upstream-weighted finite element scheme. The required inputs for flow and transport analysis are described. Detailed instructions for creating data files needed to run the program and examples of input and output files are given in appendices. GRA

N91-30464# Doty Scientific, Inc., Columbia, SC.
MICROTUBE STRIP HEAT EXCHANGER
F. D. Doty 2 Apr. 1991 12 p
(Contract DE-FG01-90CE-15440)
(DE91-009884; DOE/CE-15440/T2) Avail: NTIS HC/MF A03

During the last quarter, Doty Scientific, Inc. (DSI) continued to make progress on the microtube strip (MTS) heat exchangers. The team has begun a heat exchanger stress analysis; however, they have been concentrating the bulk of their analytical energies on a computational fluid dynmaics (CFD) model to determine the location and magnitude of shell-side flow maldistribution which decreases heat exchanger effectiveness. DSI received 120 fineblanked tubestrips from Southern Fineblanking (SFB) for manufacturing process development. Both SFB and NIST provided inspection reports of the tubestrips. DSI completed the tooling required to encapsulate a tube array and press tubestrips on the array. Pressing the tubestrips on tube arrays showed design deficiencies both in the tubestrip design and the tooling design. DSI has a number of revisions in process to correct these deficiencies. The research effort has identified a more economical fusible alloy for encapsulating the tube array, and determined the parameters required to successfully encapsulate the tube array

with the new alloy. A more compact MTS heat exchanger bank was designed. DOE

N91-30465*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
THE ENERGY DECAY IN SELF-PRESERVING ISOTROPIC TURBULENCE REVISITED Final Report
Charles G. Speziale and Peter S. Bernard (Maryland Univ., College Park.) Jul. 1991 44 p Submitted for publication
(Contract NAS1-18605)
(NASA-CR-187604; NAS 1.26:187604; ICASE-91-58) Avail: NTIS HC/MF A03 CSCL 20D

The assumption of self-preservation allows for an analytical determination of the energy decay in isotropic turbulence. Here, the self-preserving isotropic decay problem is analyzed, yielding a more complete picture of self-serving isotropic turbulence. It is proven rigorously that complete self-serving isotropic turbulence admits two general types of asymptotic solutions: one where the turbulent kinetic energy K approximately t (exp -1) and one where K approximately t (sup alpha) with an exponent alpha greater than 1 that is determined explicitly by the initial conditions. By a fixed point analysis and numerical integration of the exact one-point equations, it is demonstrated that the K approximately t (exp -1) and where K approximately t (sup -alpha) with an exponent alpha greater than 1 that is determined explicitly by the initial conditions. By a fixed point analysis and numerical integration of the exact one point equations, it is demonstrated that the K approximately t (exp -1) power law decay is the asymptotically consistent high Reynolds number solution; the K approximately 1 (sup - alpha) decay law is only achieved in the limit as t yields infinity and the turbulence Reynolds number vanishes. Arguments are provided which indicate that a K approximately t (exp -1) power law decay is the asymptotic state towards which a complete self-preseving isotropic turbulence is driven at high Reynolds numbers in order to resolve the imbalance between vortex stretching and viscous diffusion. Author

N91-30466*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
DEVELOPMENT OF TURBULENCE MODELS FOR SHEAR FLOWS BY A DOUBLE EXPANSION TECHNIQUE Final Report
V. Yakhot, S. Thangam, T. B. Gatski, S. A. Orszag (Princeton Univ., NJ.), and C. G. Speziale Jul. 1991 27 p Submitted for publication
(Contract NAS1-18605)
(NASA-CR-187611; NAS 1.26:187611; ICASE-IR-91-65) Avail: NTIS HC/MF A03 CSCL 20D

Turbulence models are developed by supplementing the renormalization group (RNG) approach of Yakhot and Orszag with scale expansions for the Reynolds stress and production of dissipation terms. The additional expansion parameter (eta) is the ratio of the turbulent to mean strain time scale. While low-order expansions appear to provide an adequate description of the Reynolds stress, no finite truncation of the expansion for the production of dissipation term in powers of eta suffices - terms of all orders must be retained. Based on these ideas, a new two-equation model and Reynolds stress transport model are developed for turbulent shear flows. The models are tested for homogeneous shear flow and flow over a backward facing step. Comparisons between the model predictions and experimental data are excellent. Author

N91-30467*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
SINGLE-BLOCK NAVIER-STOKES INTEGRATOR
P. A. Jacobs Jul. 1991 72 p
(Contract NAS1-18605)
(NASA-CR-187613; ICASE-IR-18; NAS 1.26:187613) Avail: NTIS HC/MF A04 CSCL 20D

A program is presented for the time-integration of the Navier-Stokes equations on a two dimensional structured mesh. The flow geometry may be either planar or axisymmetric. The unusual features of this program are that it is written in C and makes extensive use of sophisticated data structures to encapsulate the data. The integral form of the governing equations are given for cartesian coordinates and then the particular discretization used in the code is described. A derivation of the axisymmetric equations is also given. The full version of the code describes a flow domain as a set of abutting blocks, each consisting of a tensor-product mesh of quadrilateral cells. However, only a single-block version of the code is considered. A set of test problems is also included. Author

N91-30468*# Texas Univ., Arlington. Dept. of Aerospace Engineering.
CALCULATIONS OF STEADY AND TRANSIENT CHANNEL FLOWS WITH A TIME-ACCURATE L-U FACTORIZATION SCHEME Final Report
S.-W. Kim Aug. 1991 19 p
(Contract NCC3-180)
(NASA-CR-187071; E-6018; NAS 1.26:187071) Avail: NTIS HC/MF A03 CSCL 20D

Calculations of steady and unsteady, transonic, turbulent channel flows with a time accurate, lower-upper (L-U) factorization scheme are presented. The L-U factorization scheme is formally second-order accurate in time and space, and it is an extension of the steady state flow solver (RPLUS) used extensively to solve compressible flows. A time discretization method and the implementation of a consistent boundary condition specific to the L-U factorization scheme are also presented. The turbulence is described by the Baldwin-Lomax algebraic turbulence model. The present L-U scheme yields stable numerical results with the use of much smaller artificial dissipations than those used in the previous steady flow solver for steady and unsteady channel flows. The capability to solve time dependent flows is shown by solving very weakly excited and strongly excited, forced oscillatory, channel flows. Author

N91-30469*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
PARCHED ELASTOHYDRODYNAMIC LUBRICATION: INSTRUMENTATION AND PROCEDURE
Bryan Schritz, William R. Jones, Jr., Joseph Prahl, and Ralph Jansen (Case Western Reserve Univ., Cleveland, OH.) 1991 27 p Presented at the Annual Meeting of the Society of Tribologists and Lubrication Engineers, Philadelphia, PA, 4-7 May 1992
(NASA-TM-104426; E-6259; NAS 1.15:104426) Avail: NTIS HC/MF A03 CSCL 20D

A counter rotating bearing rig was designed and constructed to study transient elastohydrodynamic lubrication phenomena. New instrumentation is described and test procedures are documented. Ball and race speed measurement systems and the capacitance (film thickness) measurement system were upgraded. Methods for measuring bearing torque and race temperatures were implemented. Author

N91-30470 Concordia Univ., Loyola Campus, Montreal (Quebec). Dept. of Mechanical Engineering.
STUDY OF TRANSIENT JET GASES Final Report
Aaron Jaan Saber 31 Mar. 1988 372 p
(Contract DSS-01SG-97702-R-5-0682)
(CTN-91-60202) Avail: NTIS HC A16

This work involves the use of flash lamp schlieren and the development of flash lamp light slicing (planar imaging) and their employment in visualization of transient gas jets discharging into the atmosphere and the mixing that ensues. Details of the flash lamp light slicing system design are provided. Visualization of flows from a pulsed valve discharge system and a shock tube open at the downstream end of the driven section are used to simulate real discharges. Gas flow Mach numbers for discharges of air into the atmosphere range to about 0.4. Axial light slicing images show development of the starting jets, including the formation of the starting vortex and coherent structures that form along the jet shaft. Transverse light slicing images reveal the development of scallops and cusps inside the head of the jet. Voids in the jet

were observed at about 4 to 6 diameters from the exit plane. This may imply that ambient and jet gases differentiate at some points downstream. These features suggest cyclic development of jet features. The results can also be used to validate and calibrate computational fluid dynamic (CFD) computer codes used to predict the behavior of fluids under varying initial and boundary conditions. Author (CISTI)

N91-30471# California Univ., Irvine. Combustion Lab.
FUNDAMENTAL INVESTIGATION OF DUCT/ESP PHENOMENA: FLOW VISUALIZATION
C. T. Brown, W. A. Sowa, and G. S. Samuelsen Nov. 1990 43 p
(Contract DE-AC22-88PC-88850)
(DE91-010999; UCI-ARTR-90-15) Avail: NTIS HC/MF A03

The objective is to characterize the performance and behavior of twin-fluid atomizers used for in-duct sulfur capture. Such atomizers characteristically produce dense sprays featuring very narrow dispersion angles and high droplet velocities. To meet the objective, several tasks were identified (1) demonstrate the usefulness of phase Doppler interferometry to characterize humidification atomizers, (2) screen several commercially available atomizers to guide in the selection of nozzles used of field testing, and (3) develop a data base useful for computational code development and validation. The approach taken is to characterize the liquid phase produced by practical, full scale, twin-fluid humidification atomizers. Eight such twin-fluid atomizers are considered. Several of these atomizers were used in field tests. Only water sprays are considered. Atomizer responses to changes in air pressure (air flow rate) and water pressure (water flow rate) are examined. Measurements of droplet size and corresponding mean axial velocity are obtained. DOE

N91-30472*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
A LASER-INDUCED HEAT FLUX TECHNIQUE FOR CONVECTIVE HEAT TRANSFER MEASUREMENTS IN HIGH SPEED FLOWS
A. R. Porro, T. G. Keith, Jr. (Ohio Aerospace Inst., Brook Park.), and W. R. Hingst 1991 12 p Presented at the 14th International Congress on Instrumentation in Aerospace Simulation Facilities, Rockville, MD, 27-31 Oct. 1991; sponsored by IEEE Aerospace and Electronics Systems Society
(NASA-TM-105177; E-6473; NAS 1.15:105177) Avail: NTIS HC/MF A03 CSCL 20D

A technique is developed to measure the local convective heat transfer coefficient on a model surface in a supersonic flow field. The technique uses a laser to apply a discrete local heat flux at the model test surface, and an infrared camera system determines the local temperature distribution due to the heating. From this temperature distribution and an analysis of the heating process, a local convective heat transfer coefficient is determined. The technique was used to measure the local surface convective heat transfer coefficient distribution on a flat plate at nominal Mach numbers of 2.5, 3.0, 3.5, and 4.0. The flat plate boundary layer initially was laminar and became transitional in the measurement region. The experimentally determined convective heat transfer coefficients were generally higher than the theoretical predictions for flat plate laminar boundary layers. However, the results indicate that this nonintrusive optical measurement technique has the potential to measure surface convective heat transfer coefficients in high speed flow fields. Author

N91-30473*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
A QUALITATIVE VIEW OF CRYOGENIC FLUID INJECTION INTO HIGH SPEED FLOWS
R. C. Hendricks, J. Schlumberger, and M. Proctor 1991 8 p Presented at the 18th International Congress of Refrigeration, Montreal, 10-17 Aug. 1991
(NASA-TM-105139; E-6410; NAS 1.15:105139) Avail: NTIS HC/MF A02 CSCL 20D

The injection of supercritical pressure, subcritical temperature fluids, into a 2-D, ambient, static temperature and static pressure supersonic tunnel and free jet supersonic nitrogen flow field was observed. Observed patterns with fluid air were the same as those observed for fluid nitrogen injected into the tunnel at 90 deg to the supersonic flow. The nominal injection pressure was of 6.9 MPa and tunnel Mach number was 2.7. When injected directly into and opposing the tunnel exhaust flow, the observed patterns with fluid air were similar to those observed for fluid nitrogen but appeared more diffusive. Cryogenic injection creates a high density region within the bow shock wake but the standoff distance remains unchanged from the gaseous value. However, as the temperature reaches a critical value, the shock faded and advanced into the supersonic stream. For both fluids, nitrogen and air, the phenomena was completely reversible. Author

N91-30474*# Minnesota Univ., Minneapolis. Dept. of Mechanical Engineering.
BYPASS TRANSITION IN BOUNDARY LAYERS INCLUDING CURVATURE AND FAVORABLE PRESSURE GRADIENT EFFECTS Final Report
R. J. Volino and T. W. Simon Aug. 1991 137 p
(Grant NAG3-881)
(NASA-CR-187187; NAS 1.26:187187) Avail: NTIS HC/MF A07 CSCL 20D

Recent studies of 2-D boundary layers undergoing bypass transition were reviewed. Bypass transition is characterized by the sudden appearance of turbulent spots in boundary layer without first the regular, observable growth of disturbances predicted by linear stability theory. There are no standard criteria or parameters for defining bypass transition, but it is known to be the mode of transition when the flow is disturbed by perturbations of sufficient amplitude. Author

N91-30475*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
ANALYSIS OF TWO-EQUATION TURBULENCE MODELS FOR RECIRCULATING FLOWS Final Report
S. Thangam (Stevens Inst. of Tech., Hoboken, NJ.) Jul. 1991 23 p Submitted for publication
(Contract NAS1-18605)
(NASA-CR-187607; NAS 1.26:187607; ICASE-91-61) Avail: NTIS HC/MF A03 CSCL 20D

The two-equation kappa-epsilon model is used to analyze turbulent separated flow past a backward-facing step. It is shown that if the model constraints are modified to be consistent with the accepted energy decay rate for isotropic turbulence, the dominant features of the flow field, namely the size of the separation bubble and the streamwise component of the mean velocity, can be accurately predicted. In addition, except in the vicinity of the step, very good predictions for the turbulent shear stress, the wall pressure, and the wall shear stress are obtained. The model is also shown to provide good predictions for the turbulence intensity in the region downstream of the reattachment point. Estimated long time growth rates for the turbulent kinetic energy and dissipation rate of homogeneous shear flow are utilized to develop an optimal set of constants for the two equation kappa-epsilon model. The physical implications of the model performance are also discussed. Author

N91-30476*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
CALCULATION OF A CIRCULAR JET IN CROSSFLOW WITH A MULTIPLE-TIME-SCALE TURBULENCE MODEL
S.-W. Kim (Texas Univ., Arlington.) and T. J. Benson Jul. 1991 32 p
(Contract NCC3-180)
(NASA-TM-104343; E-6117; NAS 1.15:104343) Avail: NTIS HC/MF A03 CSCL 20D

Numerical calculation of a three dimensional turbulent flow of a jet in a crossflow using a multiple time scale turbulence model is presented. The turbulence in the forward region of the jet is in a stronger inequilibrium state than that in the wake region of the jet, while the turbulence level in the wake region is higher than

that in the front region. The calculated flow and the concentration fields are in very good agreement with the measured data, and it indicated that the turbulent transport of mass, concentration, and momentum is strongly governed by the inequilibrium turbulence. The capability of the multiple time scale turbulence model to resolve the inequilibrium turbulence field is also discussed. Author

N91-30477# Aeritalia S.p.A., Turin (Italy). Defence Aircraft Group.

NUMERICAL SIMULATION OF HIGH SPEED COMPRESSIBLE FLOWS WITH UPWIND SCHEMES ON ADAPTED UNSTRUCTURED GRIDS

L. Formaggia and V. Selmin 1990 11 p Presented at the 17th Conference of Int. Council of Aero. Science, Stockholm, Sweden, 9-14 Sep. 1990 Previously announced in IAA as A91-24507

(ETN-91-99771) Avail: NTIS HC/MF A03

Examples of steady two dimensional inviscid flow solutions for non reactive and reactive fluids in chemical equilibrium are presented. The flow equations are solved using a hybrid finite volume/finite element approach which adopts upwind concepts formulated in the context of unstructured grids. The algorithm is capable of quasi-second order accuracy in space by employing a MUSCL type procedure. For the chemically reacting flow computations, only first order solutions are presented. Extension of the methodology to non equilibrium flows is discussed. The geometrical flexibility of triangular unstructured grids is exploited for the development of a mesh adaptation procedure which allows to efficiently refine the grid where needed. The methodology adopted for the generation and the adaptation of the grid is described. ESA

N91-30478# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Inst. fuer Entwurfsaerodynamik.

A MULTIPLE-BLOCK MULTIGRID METHOD FOR THE SOLUTION OF THE THREE-DIMENSIONAL EULER AND NAVIER-STOKES EQUATIONS

Harold Atkins (National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.) Sep. 1991 34 p (DLR-FB-90-45; ISSN-0171-1342; ETN-91-99788) Avail: NTIS HC/MF A03; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 12.50 DM

A multiple block multigrid method for the solution of the three dimensional Euler and Navier-Stokes equations is presented. The basic flow solver is a cell vertex method which employs central difference spatial approximations and Runge-Kutta time stepping. The use of local time stepping, implicit residual smoothing, multigrid techniques and variable coefficient numerical dissipation results in an efficient and robust scheme is discussed. The multiblock strategy places the block loop within the Runge-Kutta Loop such that accuracy and convergence are not affected by block boundaries. This has been verified by comparing the results of one and two block calculations in which the two block grid is generated by splitting the one block grid. Results are presented for both Euler and Navier-Stokes computations of wing/fuselage combinations. ESA

N91-30479# European Space Agency, Paris (France).

SPECTRAL MULTI-DOMAIN APPROXIMATION OF THE NAVIER-STOKES EQUATIONS IN CURVED COMPLEX GEOMETRIES Ph.D. Thesis - Paris VI Univ., 1987

Brigitte Metivet (Office National d'Etudes et de Recherches Aerospatiales, Paris, France) May 1991 418 p Transl. into ENGLISH of Resolution Spectrale des Equations de Navier-Stokes par une Methode de Sous-Domaines Courbes (Paris, France, ONERA), 1987 182 p Original language document was announced as N88-26631

(ESA-TT-1130; ONERA-NT-1987-2; ETN-91-99793) Avail: NTIS HC/MF A18

A spectral method for solving the Navier-Stokes equations for incompressible viscous fluids in cases involving non periodic boundary conditions and complex three dimensional geometries is proposed. The following two subjects are treated theoretically and numerically: (1) the problem discretized using a finite difference time and collocation space scheme; discrete velocity and pressure spaces satisfying the inf-sup condition are chosen; (2) the situation domain of the geometry divided into subdomains which can be mapped onto a cube; the patching method is related to the Schwarz algorithm. ESA

N91-30480# Royal Aerospace Establishment, Farnborough (England). Propulsion Dept.

UNSTEADY VISCOUS FLOW IN A HIGH SPEED CORE COMPRESSOR

M. A. Cherrett and J. D. Bryce 10 Dec. 1990 14 p Presented at the 36th ASME International Gas Turbine and Aeroengine Congress and Exposition, Orlando, FL, 3-6 Jun. 1991

(RAE-TM-P-1198; BR116642; ETN-91-99854) Copyright Avail: NTIS HC/MF A03

A probe incorporating a miniature high frequency response pressure transducer traversed behind the first three stages of a high speed multistage compressor operating at throttle settings corresponding to near choke, peak efficiency and near surge, is described. A novel method of compensating for transducer temperature sensitivity was employed. Consequently, time averaged pressures derived from the transducer were found to be in good agreement with pneumatic pressure measurements. Analysis of the unsteady pressure measurements revealed both the periodic and random fluctuations in the flow field. This provided information on rotor-rotor interaction effects and the nature of viscous blade wake and secondary flows in each stage. ESA

N91-30481# Royal Aerospace Establishment, Farnborough (England).

EXPERIMENTAL INVESTIGATION OF THE SEPARATED FLOW PAST SLENDER BODIES IN THE RAE 5 METRE LOW-SPEED PRESSURISED WIND TUNNEL

S. P. Fiddes, D. E. Lean, and I. R. M. Moir 8 Mar. 1991 27 p (RAE-TM-Aero-2209; BR300696; ETN-91-99860) Copyright Avail: NTIS HC/MF A03

Tests carried out on a cone cylinder model in the 5 m low speed wind tunnel provided examples of the pressure distribution near the nose in conditions where significant values of side force occur, showing how this is dependent on roll angle of the nominally axially symmetric body. At values of roll where the side force is at its maximum, comparison of the measured pressure distribution with that predicted theoretically , using an inviscid mathematical model of the separated flow past a slender cone, shows that the major features of the flow are identified reasonably well by the inviscid model and that the development of the side force at least in its major features can be described without the need for appeal to any additional viscous interaction. Further work, however, was necessary to identify the mechanisms giving rise to intermediate values of side force. ESA

N91-30482# National Defence Research Establishment, Umea (Sweden).

FOREST FIRE SIMULATION USING PHOENICS

Erik Naeslund Feb. 1991 21 p

(FOA-C-40283-4.5; ISSN-0347-2124; ETN-91-99549) Avail: NTIS HC/MF A03; National Defence Research Establishment, NBC Defence, S-901 82 Umeaa, Sweden, HC 100 Swedish crowns

Computational fluid dynamics (CFD) is used as a tool to study the dispersion of the airborne pollutants that are originating from a forest fire. The set of relevant fluid dynamic equations is solved with the aid of the general equation solver (PHOENICS), whose graphical capability is used to display the results of the computation. The main objectives of the simulation are to show that such a dispersion model is possible to carry out, and that it gives physically reasonable results. CFD in general, and PHOENICS in particular, are shown to be a useful tool in this context. ESA

N91-30483# Technische Univ., Delft (Netherlands).
FORCES ON SHIPS IN A NAVIGATION LOCK INDUCED BY STRATIFIED FLOWS Ph.D. Thesis
Arie Vrijburcht 1991 261 p Submitted for publication Sponsored by Rijkswatertaat Original contains color illustrations
(Publ-448; ETN-91-99562) Avail: NTIS HC/MF A12

In many cases a navigation lock situated near the sea connects water bodies of different salt contents and, as a consequence, of different densities. If density differences are present, gravity will cause stratified flows when the lock is operated. These flows in particular arise during the filling of the lock chamber and after the opening of the lock gate, when the water in the lock is exchanged with that in the approach harbor. The stratified flows generate appreciable forces on a ship moored in the lock. The ship partially blocks the stratified flows and thus exerts a certain influence on them. These stratified flows, the related density distributions, and the longitudinal forces on the ship are investigated. The physical phenomena are investigated by means of laboratory and field experiments. The flows and density distributions are calculated using simplified mathematical models that contain empirical coefficients of various kinds. The coefficients are derived from the experiments. The longitudinal force on the ship is calculated using the momentum equation for a two layer flow and compared with experimental results. ESA

N91-30484# National Aerospace Lab., Amsterdam (Netherlands). Informatics Div.
COMPUTER GRAPHICS FOR FLUID FLOW ANALYSIS IN CAE
F. A. Buijsen and A. Kassies 23 Jan. 1989 19 p Presented at Conference on Computer Applications in Production and Engineering, Amsterdam, Netherlands, 9-11 May 1989
(NLR-TP-89029-U; ETN-91-99636) Avail: NTIS HC/MF A03

Many technical systems involve the use of a flow simulation system. The results of such simulations consist of vast data collections, which have to be analyzed by engineers. The only way to perform this analysis efficiently and effectively is using computer graphics techniques to present data in a visual fashion. This subject of computer graphics is called scientific visualization. Since software packages of sufficient performance and functionality are not available commercially. The National Aerospace Laboratory (NLR) has started the development of the graphical flow visualization system VISU3D. The functional requirements for such a visualization system are discussed and it is shown that the best approach for the implementation of the visualization system is to use engineering workstations in combination with a mainframe and a supercomputer. Attention is paid to the integration of the visualization system into the flow simulation process as a whole. The VISU3D started out as the visualization module of a single project for the development of a flow simulation system. It was modified into a more general tool and is now applied as a standard building block by several projects for the development of flow simulation systems. ESA

N91-30485# National Aerospace Lab., Amsterdam (Netherlands). Informatics Div.
A ROE-TYPE SCHEME FOR CHEMICALLY REACTING FLOW IN THERMAL EQUILIBRIUM
S. P. Sprekreijse 1 Feb. 1989 48 p Submitted for publication
(NLR-TP-89041-U; ETN-91-99639) Avail: NTIS HC/MF A03

A new Roe type flux difference splitting for the inviscid terms of the compressible flow equations in chemical nonequilibrium is derived under the assumption of thermal equilibrium. The splitting is a generalization of Glaister's Roe type flux difference splitting for equilibrium real gas. The resulting numerical flux function is surprisingly simple, even for a large number of species. As a result, direct coupling between the species equations and the main fluid equation set becomes an attractive approach for solving hypersonic flows in chemical nonequilibrium. ESA

N91-30486# National Aerospace Lab., Amsterdam (Netherlands). Space Div.
TEST LOOPS FOR TWO-PHASE THERMAL MANAGEMENT SYSTEM COMPONENTS
A. A. M. Delil and J. F. Heemskerk 4 May 1990 13 p Presented at 20th Intersociety Conference on Environmental Systems International Thermal Control Technology Session, Williamsburg, VA, 9-12 Jul. 1990 Previously announced in IAA as A90-49339
(Contract NIVR-2404N)
(NLR-TP-90155-U; ETN-91-99648) Avail: NTIS HC/MF A03

Two mechanically pumped two phase test rigs were built, in order to experimentally study critical issues of spacecraft two phase thermal management systems: a 5 kW, 31 mm ID, freon loop, focusing in the critical components of the ESA two phase heat transport system; a 30,000 W, 4.93 mm ID, ammonia loop, to support the development of the ESA capillary pumped loop experiment (for the in orbit demonstration of two phase heat transport system technology) and to experimentally support two phase thermal modeling and scaling activities. The rigs are described in detail. Typical test results are presented. ESA

N91-30487# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
NUMERICAL DEFINITION DOCUMENT FOR THE ISNaS TIME-EXPLICIT FLOW SOLVER
J. G. M. Kuerten Feb. 1991 78 p
(MEMO-934; ISSN-0169-2690; ETN-91-99732) Avail: NTIS HC/MF A05

Two applications of the ISNaS project related to compressible viscous flow are discussed. The first application used the flow about a multi-element airfoil. The second is the flow about a wing/body transport combination. The way in which the Navier-Stokes equations are solved numerically is described. A detailed description of the necessary discretized equations is given. Although part of the work is useful for the wing/body application, the emphasis is laid on the first application, and thus deals with a time explicit flow solver for a three dimensional geometry. A stability analysis, which gives the maximum allowable time step for this time explicit method, is presented. ESA

N91-30488# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
NUMERICAL DEFINITION DOCUMENT FOR THE ISNaS TIME-IMPLICIT FLOW SOLVER
D. Dijkstra and J. G. M. Kuerten Feb. 1991 55 p
(MEMO-935; ISSN-0169-2690; ETN-91-99733) Avail: NTIS HC/MF A04

Two applications of ISNaS project related to compressible viscous flow are discussed. The first application is the flow about a multi element airfoil. The second is the flow about a wing/body transport combination. For the second application, a time implicit monoblock is chosen. The way in which the equations are discretized and solved for this time implicit solver is outlined. Attention is paid to vectorization aspects. Stability analysis indicates that the maximum possible time step for three dimensional calculations is the same as in the time explicit flow solver. Vectorization of the proposed method is possible. ESA

N91-30489*# Pratt and Whitney Aircraft, East Hartford, CT.
EFFECTS OF ROTATION ON COOLANT PASSAGE HEAT TRANSFER. VOLUME 1: COOLANT PASSAGES WITH SMOOTH WALLS
T. J. Hajek, J. H. Wagner, B. V. Johnson, A. W. Higgins, and G. D. Steuber Washington NASA Sep. 1991 138 p
(Contract NAS3-23691)
(NASA-CR-4396-Vol-1; E-6470; NAS 1.26:4396-Vol-1) Avail: NTIS HC/MF A07 CSCL 20D

An experimental program was conducted to investigate heat transfer and pressure loss characteristics of rotating multipass passages, for configurations and dimensions typical of modern turbine blades. The immediate objective was the generation of a data base of heat transfer and pressure ioss data required to develop heat transfer correlations and to assess computational fluid dynamic techniques for rotating coolant passages. Experiments were conducted in a smooth wall large scale heat transfer model. Author

35 INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources and Remote Sensing.* For related information see also *06 Aircraft Instrumentation,* and *19 Spacecraft Instrumentation.*

N91-30490 Department of the Navy, Washington, DC.
LONG WAVELENGTH INFRARED DETECTOR WITH HETEROJUNCTION Patent
Tak-Kin Chu, inventor (to Navy) 30 Apr. 1991 5 p Filed 18 Jun. 90
(AD-D014929; US-Patent-5,012,083; US-Patent-Appl-SN-539958; US-Patent-Class-250-211J) Avail: US Patent and Trademark Office CSCL 09/1

An infrared radiation detector having a first semiconductor layer deposited on a substrate to form a diode junction with an overlay contact, is rendered more effective to detect long wavelength radiation by deposit of a second semiconductor layer between the first layer and the overlay contact in a heterojunction arrangement. The semiconductor materials are selected so as to separate radiation absorbing and electrical functions respectively performed within the two layers and to produce an enhanced output across the diode junction between the first layer and the overlay contact. GRA

N91-30491*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
GROUND-BASED PIV AND NUMERICAL FLOW VISUALIZATION RESULTS FROM THE SURFACE TENSION DRIVEN CONVECTION EXPERIMENT
Alexander D. Pline, Mark P. Wernet, and Kwang-Chung Hsieh (Sverdrup Technology, Inc., Brook Park, OH.) 1991 15 p Presented at the 36th Annual International Symposium on Optical and Optoelectronic Applied Science and Engineering, San Diego, CA, 21-26 Jul. 1991; sponsored by the Society of Photo-Optical Instrumentation Engineers
(Contract NAS3-25266)
(NASA-TM-105172; E-6468; NAS 1.15:105172) Avail: NTIS HC/MF A03 CSCL 14B

The Surface Tension Driven Convection Experiment (STDCE) is a Space Transportation System flight experiment to study both transient and steady thermocapillary fluid flows aboard the United States Microgravity Laboratory-1 (USML-1) Spacelab mission planned for June, 1992. One of the components of data collected during the experiment is a video record of the flow field. This qualitative data is then quantified using an all electric, two dimensional Particle Image Velocimetry (PIV) technique called Particle Displacement Tracking (PDT), which uses a simple space domain particle tracking algorithm. Results using the ground based STDCE hardware, with a radiant flux heating mode, and the PDT system are compared to numerical solutions obtained by solving the axisymmetric Navier Stokes equations with a deformable free surface. The PDT technique is successful in producing a velocity vector field and corresponding stream function from the raw video data which satisfactorily represents the physical flow. A numerical program is used to compute the velocity field and corresponding stream function under identical conditions. Both the PDT system and numerical results were compared to a streak photograph, used as a benchmark, with good correlation. Author

N91-30492# Aeritalia S.p.A., Turin (Italy). Flight Test Dept.
AUTOMATIC TREATMENT OF FLIGHT TEST IMAGES USING MODERN TOOLS: SAAB AND AERITALIA JOINT APPROACH
A. Kaelldahl (Saab-Space A.B., Linkoeping, Sweden) and P. Duranti 1990 11 p Presented at the 3rd European SFTE Mini-Symposium, Linkoeping, Sweden, 7-8 Jun. 1990 Prepared in cooperation with Saab-Space A.B., Linkoeping, Sweden
(ETN-91-99773) Avail: NTIS HC/MF A03

The use of onboard cine cameras, as well as that of on ground cinetheodolites, is very popular in flight tests. The high resolution of film and the high frame rate of cinecameras are still not exceeded by video technology. Video technology can successfully enter the flight test scenario once the availability of solid-state optical sensors dramatically reduces the dimensions, and weight of TV cameras, thus allowing to locate them in positions compatible with space or operational limitations (e.g., HUD cameras). A proper combination of cine and video cameras is the typical solution for a complex flight test program. The output of such devices is very helpful in many flight areas. Several sucessful applications of this technology are summarized. Analysis of the large amount of data produced (frames of images) requires a very long time. The analysis is normally carried out manually. In order to improve the situation, in the last few years, several flight test centers have devoted their attention to possible techniques which allow for quicker and more effective image treatment. ESA

N91-30493# European Space Agency, Paris (France).
ON THE TECHNOLOGY FOR PREPARATION OF A HeNe DISCHARGE TUBE FOR USE IN A LASER GYRO
Rudolf Neubauer and Werner Jungbluth (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick, Germany, F.R.) May 1991 43 p Transl. into ENGLISH of Zur Technologie der Herstellung einer HeNe-Gasentladungsroehre fuer einen Laserkreisel (Brunswick, Fed. Republic of Germany, DLR), 1990 42 p Original language document was announced as N90-29624
(ESA-TT-1222; DLR-Mitt-90-01; ETN-91-99802) Avail: NTIS HC/MF A03

A gas discharge tube with two anodes and Brewster windows is required to produce coherent measurement beams for operating a modular ring laser gyro. In order to achieve a long service life, consideration is given to the selection of helium tight glasses. A soft glass (AR Glass) is selected, ultrasound machining is carried out to the extent necessary, and the tube is joined with the aid of a described glass soldering technique. Evacuation, leak detection and filling of the gas discharge tube are described, and data are provided on the laser power achieved. A glass soldered discharge tube without the getter produced a laser beam for 25,000 hours in a linear resonator. ESA

N91-30494# National Aerospace Lab., Amsterdam (Netherlands). Space Div.
A SENSOR FOR HIGH-QUALITY TWO-PHASE FLOW
A. A. M. Delil 15 Apr. 1988 14 p Presented at 16th International Symposium on Space Technology and Science Thermophysics and Thermochemistry Session, Sapporo, Japan, 22-27 May 1988 Previously announced in IAA as A89-38154
(Contract NIVR-02502N)
(NLR-MP-88025-U; ETN-91-99649) Avail: NTIS HC/MF A03

A review of the development work and test results of a dedicated quality sensor, used to monitor the two phase heat transport systems currently considered for thermal management of large power spacecraft is presented. This sensor is based on the axial capacitance principle. Its feasibility was theoretically demonstrated. Preliminary tests with liquid layer simulating plastic sheets and with annular air/liquid flow experimentally confirm the feasibility, not only as vapor quality sensor but also as wetting (liquid layer thickness) sensor, for freons, ammonia, water, toluene, etc. Experiments in a two phase freon test loop show the sensor to be such an accurate, fastly responding, sensitive instrument, that it recently was accepted for inclusion in the two phase heat transport system developed by ESA. Recommendations for future work and applications foreseen are indicated. ESA

36 LASERS AND MASERS

Includes parametric amplifiers.
For related information see also *76 Solid-State Physics*.

N91-30495# Physical Sciences, Inc., Andover, MA.
LASER-BASED DIAGNOSTICS FOR N2(X,v) Final Report, Sep. 1987 - Oct. 1989
L. G. Piper Oct. 1990 149 p
(Contract F29601-87-C-0056)
(AD-A229310; PSI-1045/TR-960; WL-TR-90-45) Avail: NTIS HC/MF A07 CSCL 07/5

This program was designed to study diagnostics for N2(X,v) energy transfer reactions, particularly those which might be important in chemical laser systems. The program had four primary components: (1) the development of N2(X,v) diagnostics; (2) the quantitative correlation of these various diagnostics; (3) the characterization of various sources of N2(X,v); and (4) the study of N2(X,v) energy transfer reactions. GRA

N91-30496# MetroLaser, Irvine, CA.
A COMPACT PROGRAMMABLE LASER DOPPLER VELOCIMETER FOR MARINE APPLICATIONS Final Report
Cecil F. Hess Nov. 1990 38 p
(Contract N00014-90-C-0105)
(AD-A229333) Avail: NTIS HC/MF A03 CSCL 08/3

A new laser Doppler velocimeter was researched and developed deployment in the ocean. The system must be programmable and autonomous, and must operate unattended over periods of six months. The system will ultimately operate in highly dynamic shallow water environments and must be capable of providing magnitude and direction of the velocity distribution in two directions and associated flow turbulence as a function of time. The system will be utilized to measure sediment motion and a variety of ocean transport phenomena in highly dynamic situation. GRA

N91-30497# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
MICROWIGGLERS FOR SUBMILLIMETER WAVELENGTH FREE-ELECTRON LASERS Final Report, 1 Feb. 1989 - 30 Sep. 1990
George Bekefi 19 Nov. 1990 26 p
(Contract N00014-89-J-1654)
(AD-A229394) Avail: NTIS HC/MF A03 CSCL 09/3

The MIT microwiggler prototype produced on-axis magnetic fields of nearly 5 kG. Tuning was used to reduce random and systematic wiggler errors to less than or equal to 0.5 percent. Temperature measurements show that 0.5 msec, 5 kG pulses can be produced at 1 Hz at an operating temperature of 40 deg C above room temperature. We are collaborating with the Brookhaven National Laboratory to develop a lambda = 532 nm FEL using a 70-period microwiggler and a 50 MeV RF LINAC. Preliminary simulation show that oscillator operation is attainable. We have made preliminary measurements of a 20-period subsection of the MIT microwiggler. Saturation characteristics are acceptable and field uniformity without tuning is around 1 percent RMS. The enclosed photograph shows the partially assembled microwiggler whose completed length will consist of 70 periods. GRA

N91-30498# Rockwell International Science Center, Thousand Oaks, CA. Science Center.
MODEL STUDIES OF CBES DECOMPOSITION (FN3/BiF CHEMICAL LASER) Final Report, 5 Aug. 1986 - 15 Dec. 1989
D. J. Benard and B. K. Winker Oct. 1990 97 p
(Contract F04611-86-C-0072)
(AD-A229427; SC5467.FR; AL-TR-90-026) Avail: NTIS HC/MF A05 CSCL 09/3

This report investigated the use of fluorine azide (FN3) as both an advanced high energy density propellant and as a fuel for an advanced high energy visible wavelength chemical laser. The proposed laser operates by producing the electronically excited NF(a) metastable species upon thermal dissociation of FN3 and utilizing subsequent energy transfer reactions to pump the BiF(A-X) laser transitions near 450 nm. The work was done in four major blocks which include: (1) production of FN3; (2) conversion of FN3 to NF(a); (3) excitation of BiF(A) by NF(a); and (4) measurement of BiF(X). In the course of performing this work knowledge was gained concerning the mechanism of reaction and a number of key kinetic rate constants. Also efficient production of electronically excited species was demonstrated at densities large enough to power a high energy laser system. Finally, the BiF(X) ground state concentration was found to be consistent with a model based on population by radiative cascade from BiF(A) and removal by NF(a) at a near gas kinetic rate. These results support the development of an NF/BiF chemical laser that is operable at visible wavelengths. GRA

N91-30499# Wright Research Development Center, Wright-Patterson AFB, OH.
MINIMUM REQUIRED SIGNAL FOR LIMARS EXPERIMENTS
Lawrence E. Myers 31 Oct. 1990 42 p
(AD-A229524; WRDC-TM-90-120-AARI) Avail: NTIS HC/MF A03 CSCL 09/3

This report determines the minimum detectable signal required to perform the Laser Imaging and Ranging System experiment. LIMARS is a direct detection laser radar using a novel receiver scheme to produce a pixel-registered range image without scanning. This work was motivated by the need to size the transmitter laser which, for this experimental system, is a Nd:YAG laser operation at 1.06 microns. The laser must produce at least the minimum detectable power at the detector for the experimental conditions. The minimum detectable power is that power which just exceeds the noise for given probabilities of detection and false alarm. The author included contributions of noise from scene emission, scene reflection, and internal sources, and considered experiments in the Bldg 620 Tower and Bldg 622 Collimator. For the Tower experiment, in the worst case of reflected sunlight there are 410 rms noise electrons per pixel. In the Collimator experiment, internal noise of 100 rms noise electrons per pixel dominates. The author wrote a computer program to plot the probability of detection as a function of signal electrons for given probability of false alarm and number of noise electrons using Poisson statistics. Speckle was not included in this program. GRA

N91-30500*# California Univ., San Diego, La Jolla. Dept. of Applied Mechanics and Engineering Sciences.
MONOLITH CATALYSTS FOR CLOSED-CYCLE CARBON DIOXIDE LASERS Final Report, 1 Aug. 1990 - 30 Jun. 1991
Richard K. Herz and Ajay Badlani 1991 76 p
(Grant NAG1-1051)
(NASA-CR-188726; NAS 1.26:188726) Avail: NTIS HC/MF A05 CSCL 20E

The objective was to explore ways of making a monolithic form of catalyst for CO2 lasers. The approach chosen was to pelletize the catalyst material, Au/MnO2 powder, and epoxy the pellets to stainless steel sheets as structural supports. The CO oxidation reaction over Au/MnO2 powder was found to be first overall, and the reaction rate constant at room temperature was 4.4 +/- 0.3 cc/(g x sec). The activation energy was 5.7 kcal/mol. The BET surface area of the pellets was found to vary from 125 to 140 sq m/g between different batches of catalyst. Pellets epoxied to stainless steel strips showed no sign of fracture or dusting when subjected to thermal tests. Pellets can be dropped onto hard surfaces with chipping of edges but no breakage of the pellets. Mechanical strength tests performed on the pellets showed that the crush strength is roughly one-fourth of the pelletizing force. The apparent activity and activation energy over the pellets were found to be less than over the powdered form of the catalyst. The lower apparent activity and activation energy of the pellets are due to the fact that the internal surface area of a pellet is not exposed to the reactant concentration present in the flowing gas as a result of intrapellet diffusion resistance. Effectiveness factors varied from 0.44, for pellets having thickness of 2 mm and attached with epoxy to a stainless steel strip. The epoxy and the stainless steel strip were found to simply block off one of the circular faces of the pellets. The epoxy did not penetrate the pellets and block the active sites. The values of the effective diffusivities were

estimated to be between 2.3 x 10(exp -3) and 4.9 x 10(exp -3) sq cm/s. With measurements performed on one powder sample and one pellet configuration, reasonable accurate predictions can be made of conversions that would be obtained with other pellet thickness and configurations. Author

N91-30501 Colorado Univ., Boulder.
PROBABILISTIC MODEL FOR LASER LIGHT PROPAGATION THROUGH A RANDOM WATER SURFACE Ph.D. Thesis
William Clayton Brown 1990 124 p
Avail: Univ. Microfilms Order No. DA9117032

The general problem of laser light propagating through a random water surface is investigated. A theoretical model is established for characterizing this complex process and its predictions are compared with measurements made in a laboratory tank. The experiment was designed to allow channeling a variable speed air flow over the water surface so as to induce a controlled amount of surface roughness. The resulting small scale capillary wave structure of the air-water interface is probed with a laser and a 1-D lateral effects position sensor in both the crosswind and downwind directions. The surface wave angle probability density is found to be approximately Gaussian for air speeds below 3.7 m/s. The wave angle mean and standard deviation follow the driving air speed in a nearly linear manner. The surface wave spectral densities are computed and show peak values at spatial frequencies that depend on the air speed. Surface correlation times are found to decrease rapidly and to approach a constant as the air speed increases. Narrow bundles of rays refracted through the surface are dispersed into emergent angle probability densities that are modelled as a Gram-Charlier series. The fit in the downwind direction was observed to be extremely good, but it is not as good in the crosswind direction. A finite element model was constructed, based upon the Gram-Charlier models for emergent rays. This has allowed the prediction of complex light distributions above the surface for arbitrary submerged sources. The first use of this model was to predict the point spread function of a simple camera system placed above the random surface and imaged on a number of submerged objects. The theoretically predicted point spread function agrees very well with measured ones. With the use of the predicted point spread function, it was possible to effect image restorations of those blurred and distorted by the random surface. The restoration filter employed was a Wiener filter, and it was found to perform moderately well in the presence of additive noise. Dissert. Abstr.

N91-30502 Saint Andrew's Univ. (Scotland).
GENERATION AND NONLINEAR PROPAGATION OF ULTRASHORT NEAR-INFRARED LASER PULSES Ph.D. Thesis
Peter N. Kean 1989 240 p
Avail: Univ. Microfilms Order No. BRDX92110

By utilising a CW mode-locked Nd:YAG pump laser an experimental study of self-phase modulation (SPM) and stimulated Raman scattering (SRS) in single mode optical fibres has been conducted. The dependence of the spectral broadening due to SPM upon the launched optical power was observed to obey a linear relationship in agreement with a simple theory. A deviation from this occurred for high input powers due to the onset of stimulated Raman scattering which caused a preferential depletion of the leading edge of the pump pulse and an increased spectral broadening to the long wavelength side of the spectrum. The pulses exiting the fibre were then compressed using a pair of holographic diffraction gratings. By making use of Raman generation in the fibre, a synchronously pumped fibre Raman oscillator was constructed. This enabled the generation of frequency tunable near infrared pulses by the method of time dispersion tuning. Dissert. Abstr.

N91-30503 Bryn Mawr Coll., PA.
EXPERIMENTAL AND THEORETICAL STUDIES OF THE DYNAMICS OF TWO-MODE LASERS Ph.D. Thesis
Gian Luca Lippi 1990 368 p
Avail: Univ. Microfilms Order No. DA9118732

The dynamical behavior of lasers operating on two modes was studied. Two specific systems were studied: a vector laser and a bidirectional ring laser. An experimental investigation of the polarization state of the electromagnetic field vector in a quasi-isotropic He-Ne laser operating at 3.39 micron showed that there are dynamically induced changes in the total output intensity connected with changes in the state of polarization of the electric field. This confirms a recent theoretical prediction based on a very simplified model of the dynamics of these lasers. In contrast, specific models for the 3.39 micron transition in neon do not account for oscillation in the total laser intensity. To better understand the result, the behavior was studied of a He-Xe laser operating at 3.51 micron under the same experimental conditions. A modulation of the polarized components, with no oscillations in the total intensity, is observed in this case. This result indicates that a cavity anisotropy is present in the laser and suggests that oscillations in the total output intensity in the He-Ne laser come from the excitation of a damped resonance which exists in the dynamics of the population transfer mechanism among the magnetic sublevels of the laser transition. The standard two-level model for a bidirectional single longitudinal mode CO2 ring laser was analytically and numerically studied, to gain information about the topological properties of the phase space. Lasers with symmetric or asymmetric cavity loss or pump were considered. The unidirectional and zero intensity solutions are found analytically for all three cases. The bidirectional solution is also found analytically for the symmetric case. The local stability properties of the trivial and the unidirectional fixed points are investigated analytically, while the stability of the bidirectional solution is studied by numerically solving the equations. Analytical expressions for the eigenvalues and eigenvectors are obtained, providing useful information about the system and paving the way for more detailed investigations. A self-sustained bidirectional pulsing solution is found numerically (though its validity is yet to be determined) which may explain heretofore anomalous experimental results.
Dissert. Abstr.

N91-30504 Cornell Univ., Ithaca, NY.
PASSIVE Q-SWITCHING OF A DIODE-PUMPED NEODYMIUM:YAG LASER Ph.D. Thesis
Jeffrey Allen Morris 1991 88 p
Avail: Univ. Microfilms Order No. DA9117885

Compact diode-pumped neodymium:YAG lasers are becoming common commercial devices. Such lasers are often Q-switched to enhance peak power or to allow greater harmonic conversion efficiency. Active electrooptic or acoustooptic modulators are usually used to Q-switch YAG lasers. While these techniques work well, they do require expensive and bulky modulators and driving electronics. For some applications a simpler technique, such as passive Q-switching, could replace these active Q-switches. The suitability is studied of two color center materials as possible saturable absorbers for compact Nd:YAG lasers. The first material, lithium fluoride with F2- defects, has been used previously as a Q-switch for flashlamp-pumped Nd:YAG lasers. The second material, sodium chloride with F2+ defects, has not, to the author's knowledge, been used as a saturable absorber in a YAG laser. Lithium fluoride was found to be an excellent Q-switch material for a small diode-pumped YAG laser. The passively Q-switched pulses were comparable to the best results using active Q-switches. The LiF saturable absorber material is compact, inexpensive, and easy to prepare. The only discovered drawback to this material is the observation of a gradual bleaching of the saturable absorption with extended use at high peak powers. The properties and preparation of the LiF Q-switch material are described. The performance of a diode-pumped laser Q-switched with LiF is presented, including data on the pulse energy, width, and repetition rate as a function of pump power and other parameters. The mode structure of the laser is described, and observations of absorber fading are presented. The mechanism for the observed fading is also covered. The use of colored sodium chloride as a Q-switch material is also described. This material has the unique property that the amount of saturable loss in a particular crystal direction can be dynamically adjusted through the action of polarized light incident on the crystal. Thus the density of the

saturable absorber can be adjusted while it is operating in a laser. Preliminary results using NaCl as a saturable absorber are presented. Dissert. Abstr.

N91-30505# Laser Photonics Technology, Inc., Amherst, NY.
CHEMICAL PROCESSING OF NOVEL MULTIFUNCTIONAL MATERIALS FOR SENSOR PROTECTION AGAINST LASER THREATS Final Report, 15 Sep. 1990 - 15 May 1991
Ryszard Burzynski and Martin K. Casstevens 14 May 1991 28 p
(Contract F49620-90-C-0082)
(AD-A237716; AF011-FR-LPT91; AFOSR-91-0587TR) Avail: NTIS HC/MF A03 CSCL 07/3

There is an immediate need for the development of materials that could function to protect human vision and light sensitive equipment from laser based weapons. The goal of the just concluded research was to synthesize a compound that would incorporate a nonlinear two photon absorbing functional group adjacent to a photoreactive moiety. This innovative approach would lead to broad band high optical transparency at lower power levels and efficient and fast attenuation at higher power levels. The use of organic compounds in this application ensures that the molecular structure could be further optimized by careful adjustment of the molecular structure. The synthesized compound, anthracene leuconitrile, was found to be photochemically unstable and took an inappropriately long time for the reconversion from the absorbing to the transmitting form. GRA

N91-30506# City Coll. of the City Univ. of New York, NY. Ultrafast Spectroscopy and Laser Lab.
PHOTODYNAMICS AND PHYSICS BEHIND TUNABLE SOLID-STATE LASERS Final Report, 1 Jan. 1988 - 31 Dec. 1990
R. R. Alfano, V. Petricevic, and S. G. Demos 28 Feb. 1991 9 p
(Contract DAAL03-88-K-0014)
(AD-A238365; ARO-25293.16-PH) Avail: NTIS HC/MF A02 CSCL 09/3

Research was focused in two areas. The use of excite-and-probe anti-Stokes Raman scattering apparatus, the nonequilibrium phonons which participate in the overall complex nonradiative decay in tunable solid state laser crystals, were directly identified. Rise and decay behavior of different Raman-active phonon modes were measured. A new laser ion, Chromium 4(+) in chromium-doped forsterite was discovered, and its spectroscopic and laser characteristics were investigated. GRA

N91-30507# European Space Agency, Paris (France).
THEORETICAL AND EXPERIMENTAL STUDY OF KINETICS MECHANISMS IN THE CHEMICAL OXYGEN-IODINE LASER (COIL) Ph.D. Thesis - Paris Univ., 1989
Veronique Joly (Office National d'Etudes et de Recherches Aerospatiales, Paris, France) May 1991 291 p Transl. into ENGLISH of Etude Theorique et Experimentales des Mecanismes Cinetiques dans le Laser Iode-Oxygene Chimique (LIOC) (Paris, France, ONERA), Apr. 1990 164 p Original language document was announced as N91-11211
(ESA-TT-1227; ONERA-P-1990-1; ETN-91-99807) Avail: NTIS HC/MF A13

A kinetics installation and spectroscopic measurements on an iodine-metastable oxygen mixture are described. A description of the first models set up to explain the dissociation of the iodine is given. A complete model of the dissociation is described together with the calculated results obtained with the model. The model is compared with a high resolution spectroscopy experiment. The validity of each of the models described is discussed. A Coherent Anti-Stokes Raman Scattering (CARS) experiment in an iodine-oxygen mixture excited by microwaves is considered. CARS made it possible to detect the ground state and the first electronically excited state of the oxygen in the mixture. ESA

N91-30508# Helsinki Univ. of Technology, Espoo (Finland). Lab. of Graphic Arts Technology.
ON THE WAVELENGTH, TIME, AND INCLINATION VARIATIONS ON PHOTOGRAPHIC EXPOSURES WITH APPLICATIONS TO SCANNING IMAGING Ph.D. Thesis
Pekka Tuovinen 1990 29 p Repr. from Graphic Arts in Finland, v. 19, no. 3, 1990 p 3-24 Sponsored by Suomen Akatemia and Graphics Arts Research Foundation
(ETN-91-99507) Avail: NTIS HC/MF A03

Experiments performed and methods for studying the effects of wavelength and time variables of photographic exposures for optimization of imaging systems are described. Contact exposure set ups, including one with a laser rotating diffuser combination, were developed for CTF (Contrast Transfer Function) measurement at separate and simultaneously acting wavelengths in the spatial frequency range 0 to 100/mm. Apart from microdensometer MTF (Modulation Transfer Function) and adjacency effects of development, CTF relative accuracy was estimated as + or - 5 pct. A light emitting diode set up with an exposure accuracy of better than + or - 2 pct. was developed for single and double pulse sensitometry in the exposure time range of 0.25 to 50 microns and the interval between pulses of 5 to 1000 ms. A scanning laser set up provided exposure times of 4 to 400 microns and an exposure accuracy of + and - 4 pct. Results obtained can be used for the specification of equipment for sensitometry and image recording, for that of light sensitive materials, and for controlling process conditions to optimize image quality. ESA

37 MECHANICAL ENGINEERING

Includes auxiliary systems (nonpower); machine elements and processes; and mechanical equipment.

N91-30509# Boston Univ., MA. Coll of Engineering.
THE NONLINEAR CONTROL THEORY OF COMPLEX MECHANICAL SYSTEMS Final Report
J. Baillieu and M. Levi 15 Oct. 1990 59 p
(Grant AF-AFOSR-0144-85)
(AD-A229474; AFOSR-90-1155TR) Avail: NTIS HC/MF A04 CSCL 22/1

A body of research dealing with the nonlinear control theory of complex mechanical systems is summarized. The principal focus is on the dynamics of rotating systems with uncontrolled degrees of freedom, and specific model problems of pointing, shape, and orientation control of complex spacecraft in a zero gravity environment are solved. The dynamics are also examined of rotating kinematic chains. The list of references cites all major contributions to the literature of rotational mechanics. Two papers in particular - Rotational Elastic Dynamics and Equilibrium Mechanics of Rotating Systems form the principal basis for the present report. Indeed, these papers are reproduced here with occasional remarks and comments inserted regarding very recent developments in the field. GRA

N91-30510# Clemson Univ., SC.
AUTOMATED GUIDED VEHICLES Final Report, 1 Apr. - 2 Oct. 1990
John C. Peck 17 Oct. 1990 25 p
(Contract DLA900-87-D-0017)
(AD-A229477) Avail: NTIS HC/MF A03 CSCL 13/8

A considerable cost is incurred in today's manufacturing industry in the process of manually moving components between work stations. One possible means of reducing this cost may be found through the use of computer controllable Automated Guided Vehicles (AGVs). However, development of suitable computer software for the specific requirements of a plant, in a cumbersome, machine-oriented AGV Operational Language, has hindered the widespread use of AGVs. Development of such software is virtually impossible for the typical AGV user, a nonprogrammer. Various approaches considered for developing such a tool are analyzed. Finally, an impementation of one approach at the Clemson Apparel Research plant is discussed. GRA

N91-30511# General Dynamics Corp., Sterling Heights, MI. Land Systems Div.
AGT 1500 POWERPACK IMPROVEMENT PROJECT (M1 TMEPS), VOLUME 1 Final Report, May 1987 - Jun. 1990
Jonathan R. Edwards and R. Brayer Mar. 1991 170 p
(Contract DAAE07-87-C-R006)
(AD-A234998; GDLS-DB-87-04057-001A-Vol-1; TACOM-TR-13515-Vol-1) Avail: NTIS HC/MF A08 CSCL 21/7

The Transverse Mounted Engine Propulsion System Scientific and Technical Report presents the design, trade-offs, performance and cost data developed under contract DAAE-07-87-C-R006. This report contains design summaries for all automotive hardware designed and integrated into the automotive test rig. Follow-on goals are also presented for future design activities. GRA

N91-30512# General Dynamics Corp., Sterling Heights, MI. Land Systems Div.
AGT 1500 POWERPACK IMPROVEMENT PROJECT (M1 TMEPS), VOLUME 2
Jonathan R. Edwards and R. Brayer Mar. 1991 381 p
(Contract DAAE07-87-C-R006)
(AD-A234999; GDLS-DB-87-04057-001A-Vol-2; TACOM-TR-13515-Vol-2) Avail: NTIS HC/MF A17 CSCL 21/7

Compatibility of AGT 1500 and TME (AGT 1500A) engine forward and rear modules and control units was successfully demonstrated during interchangeability testing conducted between 11 July and 1 August 1989. The interchangeability test consisted of steady-state and transient evaluation of various module configurations (as specified in government contract DAC-1000001) of one AGT 1500 and one AGT 1500A (TME) automotive gas turbine selected to participate. Interchangeability testing of the standard electronic control unit and the TME digital electronic control unit (DECU) was also conducted. Steady-state engine performance demonstrated improved SFC at part power and idle with operation of the TME DECU. Trim power demonstrated for each configuration tested revealed acceptable requirements for vehicle mobility. Engine mechanical data was also found to be acceptable. GRA

N91-30513# Midwest Research Inst., Golden, CO.
VARIATIONS IN GEAR FATIGUE LIFE FOR DIFFERENT WIND TURBINE BRAKING STRATEGIES
B. P. McNiff, W. D. Musial, and R. Errichello (GEARTECH, Albany, CA.) Jun. 1991 10 p Presented at the Windpower 1990, Washington, 25-28 Sep. 1990
(Contract DE-AC02-83CH-10093)
(DE91-002161; SERI/TP-257-3984; CONF-9009107-7) Avail: NTIS HC/MF A02

A large number of gearbox failures have occurred in the wind industry in a relatively short period, many because service loads were underestimated. High-torque transients that occur during starting and stopping are difficult to predict and may be overlooked in specifying gearbox design. Although these events comprise a small portion of total load cycles, they can be the most damaging. The severity of these loads varies dramatically with the specific configuration of the wind turbine. The large number of failures in Danish-designed Micon 65 wind turbines prompted this investigation. The high-speed and low-speed shaft torques were measured on a two-stage helical gearbox of a single Micon 65 turbine. Transient events and normal running loads were combined statistically to obtain a typical annual load spectrum. The pitting and bending fatigue lives of the gear teeth were calculated by using Miner's rule for four different high-speed shaft brake configurations. Each breaking scenario was run for both a high- and a low-turbulence normal operating load spectrum. The analysis showed increases in gear life by up to a factor of 25 when the standard high-speed shaft brake is replaced with a dynamic brake or modified with a damper. DOE

N91-30514# Energy Task Force, Inc., New York, NY.
AN ALTERNATIVE FUELS EVALUATION SYSTEM FOR FLEET VEHICLES
Dec. 1990 124 p Prepared in cooperation with City of Denver, CO
(Contract DE-FG02-78IR-05106)
(DE91-013434; DOE/IR-05106/T139) Avail: NTIS HC/MF A06

This report describes a fuel-neutral, broad-based, automated evaluated system for comparing new alternative fuels and technologies to existing gasoline and diesel vehicles. Developed by Denver's Department of Health and Hospitals, the evaluation system provides fleet managers and policy makers with a tool for weighing the advantages and disadvantages of the major fuel alternatives (compressed natural gas, electricity, ethanol, methanol, LPG, and blended fuels). The results are available by category (e.g., emissions, national security), in a box score of sorts, which compares all the categories against each other. The system does not provide a definitive statement on how various fuels compare to gasoline or diesel. Rather, it can produce any number of comparisons based on the best available data and a weighting priority as determined by the user. DOE

N91-30515 Michigan State Univ., East Lansing.
MULTIOBJECTIVE OPTIMIZATION DESIGN STRATEGIES FOR ARTICULATING MECHANISMS AND ROBOTIC MANIPULATORS FABRICATED FROM ADVANCED POLYMERIC FIBER-REINFORCED COMPOSITE MATERIALS Ph.D. Thesis
Lu-Ping Chao 1990 183 p
Avail: Univ. Microfilms Order No. DA9111573

A theoretical and experimental study is undertaken to investigate the performance of articulating linkage mechanisms incorporating symmetric composite laminated links operating in various hygrothermal environments. The theoretical investigation is focused upon developing a finite element model to predict the hygrothermal elastodynamic response of four-bar linkage mechanisms. In a complimentary investigation, an experimental program focuses on the elastodynamic response of a four-bar mechanism with composite laminated coupler links fabricated from various configurations of Hercules AS4/3501-6 prepreg and subjected to a variety of hygrothermal conditions. The single-objective optimization design methodology is developed for robotic manipulators fabricated from fiberous composite materials. A numerical simulation demonstrates that the optimal design methodology has an efficient design process when compared with arbitrarily intuitive design. A strategy for the application of fuzzy set theory to multi-objective optimal design methodology has an efficient design process when compared with arbitrarily intuitive design. A strategy for the application of fuzzy set theory to multi-objective optimal design requirements of a composite-based robot arm is developed to choose the compromise solution. The formulation of the fuzzy multi-objective optimization design problem is accomplished by integrating design variables and by defining the fuzzy domains corresponding to the objective functions and the constraints. The fuzzy multi-objective optimization problem is solved by using conventional single-objective function programming techniques. Design for manufacturing strategies for incorporating manufacturing uncertainties in the robust design of composite structures are proposed. A methodology for the application of chance constrained programming to stochastic design optimization of composite-based structures is presented. A sensitivity analysis of the dynamic response of composite structures is developed as a prerequisite to obtaining the optimal solution. This formulation is then employed to study the transient response of cantilever beams in order to demonstrate the significance of incorporation random parameters into traditional deterministic optimization design methodologies. Dissert. Abstr.

N91-30516 Illinois Univ., Urbana-Champaign.
VIBRATIONAL CONTROL: APPLICATION TO A LASER-ILLUMINATED REACTION AND EXTENSION TO NONLINEAR FUNCTIONAL DIFFERENTIAL EQUATIONS Ph.D.

Thesis
Jamel Fakhfakh 1990 117 p
Avail: Univ. Microfilms Order No. DA9114232

There were two major goals: (1) to implement vibrational control technique in a physical system to verify its potential applicability as an alternative to feedback; and (2) to extend vibrational control theory to a more general class of systems, namely nonlinear systems with finite time delays. To achieve the first goal, the laser illuminated thermochemical reaction, S2O6F2 yields (reversible) 2 SO3F*, was chosen. Numerical simulation and experimental work were carried out for the case of a rectangular wave oscillating incident laser power. It was shown experimentally that such parametric vibrations can indeed induce asymptotically stable operating regimes with averages located at initially unstable steady states as predicted by vibrational control theory. Hence, vibrational control is demonstrated to be a feasible stabilizing strategy for laser induced reactions that needs no on-line measurements and complex actuators. For the second goal, three problems of control of nonlinear systems with time delays were addressed: (1) an existence and a synthesis of parametric vibrations for their stabilization; (2) the transient behavior analysis of the vibrationally controlled nonlinear systems with time lags; and (3) the robustness analysis of this class of systems with respect to the vibration parameters. Stabilizability conditions for two vibration types are formulated and procedures for the synthesis of the corresponding stabilizing vibrations are proposed. The method for the transient behavior analysis of vibrationally controlled systems on a finite time interval is developed as well. Several examples are given to support the theory presented. Dissert. Abstr.

N91-30517 Stanford Univ., CA.
EXPERIMENTS IN END-POINT POSITION AND FORCE CONTROL OF A MINIMANIPULATOR ON A FLEXIBLE-DRIVE MANIPULATOR Ph.D. Thesis
Brian Lee Andersen 1991 213 p
Avail: Univ. Microfilms Order No. DA9115735

An experimental study is presented of the use of a minimanipulator carried by a flexible main manipulator to control either the tip position or the force applied to the environment. Most robotic tasks entail a great deal of manipulation in a few localized workspaces. A minimanipulator can be used to perform these tasks in the localized workspace at a higher bandwidth and precision than can be achieved by the main manipulator alone. A method is developed for designing control algorithms for the minimanipulator in which the dynamics of the main manipulator need not be included. Only the disturbance that the minimanipulator produces on the main manipulator must be computed in order to determine whether the main manipulator will take the minimanipulator out of range. It is shown that the need to switch control modes can be avoided: the same controller used to regulate tip position when the manipulator is out of contact can be used when the manipulator is in contact with the addition of an outer loop that uses force errors to adjust the commanded position for the inner loop. The procedures were implemented using a two-link manipulator having flexible tendon drives and a minimanipulator at its tip. Experimental results are presented for positioning of the tip, for regulation of force, and for achieving smooth contact.
Dissert. Abstr.

N91-30518 Stanford Univ., CA.
EXPERIMENTS IN COOPERATIVE-ARM OBJECT MANIPULATION WITH A TWO-ARMED FREE-FLYING ROBOT Ph.D. Thesis
Ross Koningstein 1991 217 p
Avail: Univ. Microfilms Order No. DA9115798

Developing computed-torque controllers for complex manipulator systems using current techniques and tools is difficult because they address the issues pertinent to simulation, as opposed to control. A new formulation of computed-torque (CT) control that leads to an automated computed-torque robot controller program is presented. This automated tool is used for simulations and experimental demonstrations of endpoint and object control from a free-flying robot. A new computed-torque formulation states the multibody control problem in an elegant, homogeneous, and practical form. A recursive dynamics algorithm is presented that numerically evaluates kinematics and dynamics terms for multibody systems given a topological description. Manipulators may be free-flying, and may have closed-chain constraints. With the exception of object squeeze-force control, the algorithm does not deal with actuator redundancy. The algorithm is used to implement an automated 2D computed-torque dynamics and control package that allows joint, endpoint, orientation, momentum, and object squeeze-force control. This package obviates the need for hand-derivation of kinematics and dynamics, and is used for both simulation and experimental control. Endpoint control experiments are performed on a laboratory robot that has two arms to manipulate payloads, and uses an air bearing to achieve very-low drag characteristics. The robot's base body mass and inertia are considerably larger than that of the manipulator arm segments, much like NASA's proposed Orbital Maneuvering Vehicle. Simulations and experimental data for endpoint and object controllers are presented for the experimental robot - a complex dynamic system. There is a certain rather wide set of conditions under which CT endpoint controllers can neglect robot base accelerations (but not motions) and achieve comparable performance to including base accelerations in the model. The regime over which this simplification holds is explored by simulation and experiment. These simplifications can result in a savings of an order of magnitude of computation in the controller. Momentum control via external forces and torques (e.g., thrusters) is provided for in the formulations, but is not done in this study.
Dissert. Abstr.

N91-30519 Bath Univ. (England).
CONTROL OF VIBRATION IN A FLEXIBLE ROTOR-BEARING SYSTEM Ph.D. Thesis
M. A. Baseer 1990 321 p
Avail: Univ. Microfilms Order No. BRDX91984

The historical development in the study of vibration problems in rotating machinery is traced. The main causes of vibration in rotor-bearing systems are summarized. Different methods of vibration control and their optimum areas of application are discussed. Both passive and active vibration control devices are described. A review of analytical methods in rotor dynamics is presented. A comprehensive discussion of lumped parameter representations of distributed systems furnishes the basic modeling knowledge of flexible rotor-bearing systems. Modeling rules for attaining optimum accuracy with lumped-parameter modeling are discussed in detail. Analytical methods commonly used for the determination of the critical speeds and steady state response to imbalance are described. Various numerical methods available for computing the transient response of flexible rotor-bearing systems, subjected to a sudden change in imbalance are described. Nonlinearities arising at the journal bearings are discussed. A method is introduced for performing a nonlinear transient analysis of a flexible rotor-bearing system, operating under simulated blade loss conditions. The formulation of a suitable control strategy for the active control of vibration in a flexible rotor-bearing system caused by steady as well as sudden changes in imbalance is described. The experimental set up and data acquisition system are also described, and the essential features of the test rotor-bearing systems are summarized. The microcomputer-based data acquisition system used to implement the control strategy is discussed. The test results are presented, and the purpose was to obtain experimental data on the use of an electromagnetic actuator for active control of synchronous as well as transient vibration in a flexible rotor-bearing system under conditions simulating those which might occur in a rotating machine in case of a component loss. A description of the blade loss mechanism is included. Dissert. Abstr.

N91-30520 Texas Univ., Austin.
DYNAMIC MODELING, PROPERTY INVESTIGATION, AND ADAPTIVE CONTROLLER DESIGN OF SERIAL ROBOTIC MANIPULATORS MODELED WITH STRUCTURAL

COMPLIANCE Ph.D. Thesis
Shyng-Her Lin 1990 362 p
Avail: Univ. Microfilms Order No. DA9116910

Research results on general serial robotic manipulators modeled with structural compliances are presented. Two compliant manipulator modeling approaches, distributed and lumped parameter models, are used. System dynamic equations for both compliant models are derived by using the first and second order influence coefficients. Also, the properties of compliant manipulator system dynamics are investigated. One of the properties, which is defined as the inaccessibility of vibratory modes, is shown to display a distinct character associated with compliant manipulators. This property indicates the impact of robot geometry on the control of structural oscillations. Example studies are provided to illustrate the physical interpretation of the inaccessibility of vibratory modes. Two types of controllers are designed to control compliant manipulators. These controllers are designed for compliant manipulators modeled by either lumped or distributed parameter techniques. In order to maintain the generality of the results, neither linearization is introduced nor any nonlinear term neglected to simplify the controller design problem. The first type controller is built for N-degree-of-freedom robots with known system parameters, and several distinct control algorithms are introduced. Example simulations are given to demonstrate the controller performance. The second type controller is also built for general serial robot arms and is adaptive in nature, and it is capable of estimating uncertain payload parameters on-line and simultaneously maintaining trajectory tracking properties. The relation between manipulator motion tracking capability and convergence of parameter estimation properties is discussed through example case studies. The effect of control input update delays on adaptive controller performance is also studied. Dissert. Abstr.

N91-30521 Council for National Academic Awards (England).
VIBRATION CONTROL IN ROTATING MACHINERY USING VARIABLE DYNAMIC STIFFNESS HYDROSTATIC SQUEEZE-FILMS Ph.D. Thesis
M. P. Roach 1990 271 p
Avail: Univ. Microfilms Order No. BRDX91965

The development and testing of a support design for use with rotating machinery is discussed. The support design is based on the centralized squeeze-film currently in use with aircraft engines. To allow the dynamic load support stiffness value to be varied between high hydrostatic support values and near-zero values during machine operation, capillary flow restrictors and remote-controlled solenoid values were introduced between the accumulators and the hydrostatic recesses. The support system was tested experimentally with a multi-mass flexible rotor running on rolling element bearings which modeled a General Electric TF 34 turbofan engine compressor shaft. The static and dynamic characteristics of the supports were modeled theoretically using fluid-flow continuity equations which accounted for fluid inertia and compressibility effects, with the circumferential land squeeze-film effects assumed to be acting in parallel with the hydrostatic effects. The shaft and rotor steady-state response to unbalance was determined theoretically using a transfer matrix method, and the stability of the system was determined by examining the complex roots of the system characteristic equations. Both the theoretical and experimental results show that the introduction of the accumulator-modified hydrostatic squeeze-film supports can result in significant improvements to a machine's stability, steady-state vibration levels and support force transmission in comparison with conventional support designs. Support stiffness and damping values were identified which maximize both the machine stability and the steady-state response to unbalance attenuation and are shown to be dependent upon certain machine parameters. Hydrostatic support instability was shown to be possible with high fluid compressibility values or with the introduction of the accumulators; however, such instability was found to be suppressed by the squeeze-film damping forces generated by the circumferential lands resulting in stability levels significantly above those achieved with conventional support systems. Dissert. Abstr.

N91-30522 State Univ. of New York, Stony Brook.
STOCHASTIC MODELS FOR MANIPULATOR ANALYSIS AND SYNTHESIS Ph.D. Thesis
Jai Raj Singh 1990 195 p
Avail: Univ. Microfilms Order No. DA9106827

A new probabilistic method to obtain the distribution of the volumes of the velocity and force ellipsoids, the workspace, all subspaces and the configurations (branches) of any arbitrary nonredundant manipulator is presented. The validity of this method is proved in the form of Lemmas. The method is illustrated by an example for a 2R manipulator. New concepts, referred to as the global velocity ellipsoid and the global inertia ellipsoid, which represent, respectively, the global motion manipulability and the global inertia of a manipulator, are introduced. Various global parameters which measure the global manipulability, velocity, inertia, nonlinearity and coupling characteristics of the manipulator are presented. These global parameters are then used for optimizing the kinematic structure and mass distribution of manipulator links. The effect of payload range is also included in the design. A stochastic model of the motion of robot manipulators within probabilistically defined task spaces is developed. The model is applied to solve a number of problems of interest. The optimal actuator limits for prescribed cycle time are determined. The effects of the geometric shape of the task space on the manipulator performance characteristics, and the optimal location of a task space within the workspace of a manipulator is determined. The performance of manipulators in the presence of random obstacles is studied. A stochastic formulation of tasks to be performed by the manipulator in the presence of random obstacles is obtained. The expected (mean) cycle time and its variance are determined and taken as the criteria of manipulator performance. The potential of the model for determining the optimal location of sensing devices, and for the evaluation of the performance of the various obstacle avoidance algorithms is illustrated through a number of simple examples. The problem of determining the optimal locations and trajectories of the end-effector such that the manipulator can respond in minimum time to any command, is addressed. The model is intended to be used to effectively utilize the periods during which the manipulator is idle, such as, while waiting for some new commands. Several examples are presented to illustrate the concepts. Dissert. Abstr.

N91-30523 Wisconsin Univ., Milwaukee.
ADMISSIBLE MOTIONS IN MANIPULATOR'S WORKSPACE Ph.D. Thesis
Kao-Yueh Tsai 1990 278 p
Avail: Univ. Microfilms Order No. DA9119191

The singular manifolds in task space divide the workspace of manipulators into different regions with varying accessibilities (2,4,...16). The trajectory planning for a move of the end-effector from an m-root region (each point in this region can be accessed by m configurations) to an n-root region, there are, theoretically, at most only n configurations that allow to reach the goal if m greater than n, m - n configurations are lost (their corresponding inverse kinematic solutions become complex roots) when the end-effector crosses some noncrossable singular manifolds. For general manipulators, it is difficult to determine (unless simulation is used) which configuration can accomplish the task. In this work, it is shown that for most general manipulators, any configuration from any region can always reach any position (in any region n greater than m, n = m or n less than m) in the workspace without encountering Jacobian singularities. Singular manifolds in joint space also divide the joint space into disjointed regions. The kinematic map restricted to each region is a global diffeomorphism for special manipulators. Since the inverse kinematics is a one to many map, the preimage of singular manifolds in task space are not necessarily singular points in joint space. The set of preimage of the singular manifolds in task space with the determinant of the Jacobian matrix not equal to zero are defined as pseudo singular manifolds in joint space. Pseudo singular manifolds further (along with singular manifolds) divide the joint space into patches. An n-root region in the task space is covered by n patches in the joint space and the kinematic map restricted to each patch is a

global diffeomorphism. Singularity is the most important factor that affects the robot motion planning in the task space. In this work, the theorems and algorithms to locate all branches of singular manifolds and their submanifolds (which play an important role in robot motions) are developed and the local maps near these submanifolds are investigated. Dissert. Abstr.

N91-30524*# Georgia Inst. of Tech., Atlanta. School of Mechanical Engineering.
MANIPULATION STRATEGIES FOR MASSIVE SPACE PAYLOADS Semiannual Progress Report, 15 Nov. 1990 - 14 May 1991
Wayne J. Book 1991 121 p
(Grant NAG1-623)
(NASA-CR-188722; NAS 1.26:188722) Avail: NTIS HC/MF A06 CSCL 13I

Motion planning and control for the joints of flexible manipulators are discussed. Specific topics covered include control of a flexible braced manipulator, control of a small working robot on a large flexible manipulator to suppress vibrations, control strategies for ensuring cooperation among disparate manipulators, and motion planning for robots in free-fall. For individual titles, see N91-30525 through N91-30530.

N91-30525*# Georgia Inst. of Tech., Atlanta.
CONTROL OF A FLEXIBLE BRACING MANIPULATOR: INTEGRATION OF CURRENT RESEARCH WORK TO REALIZE THE BRACING MANIPULATOR
Dong-Soo Kwon *In its* Manipulation Strategies for Massive Space Payloads 1991 p 10-11 (For primary document see N91-30524 22-37)
Avail: NTIS HC/MF A06 CSCL 13I

All research results about flexible manipulator control were integrated to show a control scenario of a bracing manipulator. First, dynamic analysis of a flexible manipulator was done for modeling. Second, from the dynamic model, the inverse dynamic equation was derived, and the time domain inverse dynamic method was proposed for the calculation of the feedforward torque and the desired flexible coordinate trajectories. Third, a tracking controller was designed by combining the inverse dynamic feedforward control with the joint feedback control. The control scheme was applied to the tip position control of a single link flexible manipulator for zero and non-zero initial condition cases. Finally, the contact control scheme was added to the position tracking control. A control scenario of a bracing manipulator is provided and evaluated through simulation and experiment on a single link flexible manipulator. Author

N91-30526*# Georgia Inst. of Tech., Atlanta.
CONTROL OF A SMALL WORKING ROBOT ON A LARGE FLEXIBLE MANIPULATOR FOR SUPPRESSING VIBRATIONS: DEVELOPMENT OF A ROBUST CONTROL LAW FOR FLEXIBLE ROBOT AND IT'S STABILITY ANALYSIS Abstract Only
Han Lee Soo *In its* Manipulation Strategies for Massive Space Payloads 1991 p 12-13 (For primary document see N91-30524 22-37)
Avail: NTIS HC/MF A06 CSCL 13I

Researchers developed a robust control law for slow motions for the accurate trajectory control of a flexible robot. The control law does not need larger velocity gains than position gains, which some researchers need to ensure the stability of a rigid robot. Initial experimentation for the Small Articulated Manipulator (SAM) shows that control laws that use smaller velocity gains are more robust to signal noise than the control laws that use larger velocity gains. Researchers analyzed the stability of the composite control law, the robust control for the slow motion, and the strain rate feedback for the fast control. The stability analysis was done by using a quadratic Liapunov function. Researchers found that the flexible motion of links could be controlled by relating the input force to the flexible signals which are sensed at the near tip of each link. The signals are contaminated by the time delayed input force. However, the effect of the time delayed input force can be reduced by giving a certain configuration to the SAM. Author

N91-30527*# Georgia Inst. of Tech., Atlanta.
CONTROL STRATEGY FOR COOPERATING DISPARATE MANIPULATORS: NON-COLOCATED CONTROL OF DISTURBANCES OF A FLEXIBLE ARM Abstract Only
Jae Y. Lew *In its* Manipulation Strategies for Massive Space Payloads 1991 p 14-15 (For primary document see N91-30524 22-37)
Avail: NTIS HC/MF A06 CSCL 13I

The long term objectives for this research are to use a small robot arm to compliment a large robot arm. Disturbances generated by robot tasks were studied. Available equipment made it convenient to study disturbances generated by an abrasive cut off saw mounted on the tip of a large armed robot, and used to cut through rods and pipes in the range of 0.5 in. to 1.5 in. The abrasive process was modeled as a friction operation. The operation of the cut off saw was performed autonomously and under teleoperated control. The behavior was stable in both cases for a P-D joint control algorithm. It was found that broad band excitation during the cutting operation is capable of exciting arm natural frequencies to above the third natural frequency of the arm. The direction of cut changed the modes excited due to the change in coupling coefficients. Author

N91-30528*# Georgia Inst. of Tech., Atlanta.
AN INVERSE DYNAMIC TRACKING CONTROL FOR BRACING A FLEXIBLE MANIPULATOR Abstract Only
In its Manipulation Strategies for Massive Space Payloads 1991 2 p (For primary document see N91-30524 22-37)
Avail: NTIS HC/MF A06 CSCL 13I

The goal of this research is to produce a braced manipulator that is flexible. In order to brace the manipulator against a surface, a tip position tracking control becomes essential to avoid large impacts on contact, and to control the force after contact. If we consider the characteristics of the flexible manipulator, the control task may be characterized as a tracking control of a nonlinear, noncolocated, nonminimum-phase system with uncertainties. First, the author introduces the staged positioning concept and provides a conceptual background for the bracing strategy. Second, a single link flexible manipulator is modeled by the assumed-modes method, and the validity of the model is verified with experimental results. Third, a time domain inverse dynamic method is proposed to cancel out the nonminimum-phase positive zeros which cannot be cancelled by feedback controls. Fourth, a tracking controller is designed to control the end point of a flexible manipulator without any overshoot or residual vibrations. Its perfect tracking or asymptotic tracking performance is analyzed and discussed for zero and non-zero initial condition cases. Finally, impact phenomena are investigated, and contact force control of a flexible bracing manipulator is presented to set up a control scenerio for such a manipulator. The proposed control scheme is implemented on a single link flexible manipulator, and analyzed and evaluated with simulations and experiments. Author

N91-30529*# Georgia Inst. of Tech., Atlanta. School of Mechanical Engineering.
EXPERIMENTAL INVESTIGATIONS OF THE EFFECTS OF CUTTING ANGLE ON CHATTERING OF A FLEXIBLE MANIPULATOR
J. Lew, J. Huggins, D. Magee, and W. Book *In its* Manipulation Strategies for Massive Space Payloads 1991 6 p (For primary document see N91-30524 22-37)
Avail: NTIS HC/MF A06 CSCL 13I

When a machine tool is mounted at the tip of a robotic manipulator, the manipulator becomes more flexible (the natural frequencies are lowered). Moreover, for a given flexible manipulator, its compliance will be different depending on feedback gains, configurations, and direction of interest. Here, the compliance of a manipulator is derived analytically, and its magnitude is represented as a compliance ellipsoid. Then, using a two-link flexible manipulator with an abrasive cut off saw, the experimental

investigation shows that the chattering varies with the saw cutting angle due to different compliance. The main work is devoted to finding a desirable cutting angle which reduces the chattering.
Author

N91-30530*# Georgia Inst. of Tech., Atlanta.
PLANNING AND EXECUTING MOTIONS FOR MULTIBODY SYSTEMS IN FREE-FALL Ph.D. Thesis
Jonathan M. Cameron *In its* Manipulation Strategies for Massive Space Payloads 1991 55 p (For primary document see N91-30524 22-37)
Avail: NTIS HC/MF A06 CSCL 13I

The purpose of this research is to develop an end-to-end system that can be applied to a multibody system in free-fall to analyze its possible motions, save those motions in a database, and design a controller that can execute those motions. A goal is for the process to be highly automated and involve little human intervention. Ideally, the output of the system would be data and algorithms that could be put in ROM to control the multibody system in free-fall. The research applies to more than just robots in space. It applies to any multibody system in free-fall. Mathematical techniques from nonlinear control theory were used to study the nature of the system dynamics and its possible motions. Optimization techniques were applied to plan motions. Image compression techniques were proposed to compress the precomputed motion data for storage. A linearized controller was derived to control the system while it executes preplanned trajectories. Author

N91-30531*# Ohio State Univ., Columbus. Dept. of Mechanical Engineering.
FUNDAMENTALS OF FLUID LUBRICATION
Bernard J. Hamrock Washington NASA Aug. 1991 670 p Sponsored by NASA. Lewis Research Center
(NASA-RP-1255; E-3758; NAS 1.61:1255) Avail: NTIS HC/MF A99 CSCL 13I

The aim is to coordinate the topics of design, engineering dynamics, and fluid dynamics in order to aid researchers in the area of fluid film lubrication. The lubrication principles that are covered can serve as a basis for the engineering design of machine elements. The fundamentals of fluid film lubrication are presented clearly so that students that use the book will have confidence in their ability to apply these principles to a wide range of lubrication situations. Some guidance on applying these fundamentals to the solution of engineering problems is also provided. Author

N91-30532*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
SPACE MECHANISMS NEEDS FOR FUTURE NASA LONG DURATION SPACE MISSIONS
Robert L. Fusaro 1991 12 p Presented at the Conference on Advanced Space Exploration Initiative Technologies, Cleveland, OH, 4-6 Sep. 1991; sponsored by AIAA, NASA, and OAI
(NASA-TM-105204; E-6507; NAS 1.15:105204) Avail: NTIS HC/MF A03 CSCL 13I

Future NASA long duration missions will require high performance, reliable, long lived mechanical moving systems. In order to develop these systems, high technology components, such as bearings, gears, seals, lubricants, etc., will need to be utilized. There has been concern in the NASA community that the current technology level in these mechanical component/tribology areas may not be adequate to meet the goals of long duration NASA mission such as Space Exploration Initiative (SEI). To resolve this concern, NASA-Lewis sent a questionnaire to government and industry workers (who have been involved in space mechanism research, design, and implementation) to ask their opinion if the current space mechanisms technology (mechanical components/tribology) is adequate to meet future NASA Mission needs and goals. In addition, a working group consisting of members from each NASA Center, DoD, and DOE was established to study the technology status. The results of the survey and conclusions of the working group are summarized. Author

N91-30533*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
TRANSMISSION OVERHAUL ESTIMATES FOR PARTIAL AND FULL REPLACEMENT AT REPAIR
M. Savage (Akron Univ., OH.) and D. G. Lewicki 1991 8 p Presented at the International Conference on Motion and Power Transmissions, Hiroshima, Japan, 24-26 Nov. 1991; sponsored by the Japan Society of Mechanical Engineers with the participation of ASME, I. Mech. E., VDI, I.E.T., CSME and other societies
(DA Proj. 1L1-62211-A-47A)
(NASA-TM-104395; E-6211; NAS 1.15:104395; AVSCOM-TR-91-C-010) Avail: NTIS HC/MF A02 CSCL 13I

Timely transmission overhauls increase in-flight service reliability greater than the calculated design reliabilities of the individual aircraft transmission components. Although necessary for aircraft safety, transmission overhauls contribute significantly to aircraft expense. Predictions of a transmission's maintenance needs at the design stage should enable the development of more cost effective and reliable transmissions in the future. The frequency is estimated of overhaul along with the number of transmissions or components needed to support the overhaul schedule. Two methods based on the two parameter Weibull statistical distribution for component life are used to estimate the time between transmission overhauls. These methods predict transmission lives for maintenance schedules which repair the transmission with a complete system replacement or repair only failed components of the transmission. An example illustrates the methods. Author

N91-30534# Aeronautical Research Labs., Melbourne (Australia).
AN INVESTIGATION OF VIBRATION SIGNAL AVERAGING OF INDIVIDUAL COMPONENTS IN AN EPICYCLIC GEARBOX
I. M. Howard Jun. 1991 81 p
(ARL-PROP-R-185; AR-006-147) Copyright Avail: NTIS HC/MF A05

An investigation of vibration signal averaging for individual components in an epicyclic gearbox was conducted. A new signal averaging technique was developed specifically for analyzing planetary gears within epicyclic transmissions using the vibration measured on the annulus gear casing. It enables the acquisition of signal averages for individual planetary gears, whereas previous methods gave a composite vibration pattern from all the planet gears. The new technique is outlined and its implementation is described. Results of tests on an epicyclic gearbox showed the advantages of separating individual planetary gear averages, compared with previous methods. Other conclusions include the effects of transducer location, number of tooth mesh cycles averaged, window width and the use and difficulties with the composite sun gear signal average. Author

N91-30535# Kumm (Emerson L.), Phoenix, AZ.
FLAT BELT CONTINUOUSLY VARIABLE HIGH SPEED DRIVE
1991 15 p
(Contract DE-FG01-90CE-15470)
(DE91-011032; DOE/CE-15470/T3) Avail: NTIS HC/MF A03

The contracted work calls for the design, construction, and test of flat belt pulley equipment that would demonstrate the practicality of transferring substantial power (up to 37.5 kW) from a high speed turbine shaft (50,000 RPM) to much lower speed output shaft with the availability of varying the speed of the output shaft over a two to one speed range relative to the high speed shaft. Such operation would permit the power available from an exhaust gas turbine to be more efficiently utilized in a turbo-charged diesel engine. The overall work progress corresponds quite well with expenditures made to data. At the end of March, 1991, the preliminary and detailed design is complete including analyses together with drawings (about 30 to date) of the test components. DOE

N91-30536*# Catholic Univ. of America, Washington, DC. Dept. of Electrical Engineering.
A STUDY OF SPACE-RATED CONNECTORS USING A ROBOTIC END-EFFECTOR Semiannual Progress Report, 1 Apr. - 1 Sep. 1991
Charles C. Nguyen and Sami S. Antrazi Sep. 1991 85 p
(Grant NAG5-1415)
(NASA-CR-188776; NAS 1.26:188776) Avail: NTIS HC/MF A05 CSCL 13I

The fabrication and testing of a pair of robot fingers designed to grasp two types of Orbital Replacement Unit (ORU) interfaces, the H Handle type and the Micro Square type are discussed. A closed-form solution is given for the force inverse kinematics. A numerical solution using the Newton-Raphson Method for force forward kinematics is given. Mathematical expressions are derived to compute forces/torques applied to the finger. Suggestions are given for improving finger fabrication. The results of numerous experiments conducted to study the characteristics and feasibility of the fingers are given. The first part of the study was devoted to obtaining data on the forces applied by the finger to the interfaces under various translational and rotational misalignments; the second part was devoted to determining the maximum allowed capture angles that would insure successful mating; and the third part was devoted to the processing and interpretation of the forces/torque data. Author

N91-30537*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
HOW TO DETERMINE SPIRAL BEVEL GEAR TOOTH GEOMETRY FOR FINITE ELEMENT ANALYSIS
Robert F. Handschuh and Faydor L. Litvin (Illinois Univ., Chicago.) 1991 9 p Proposed for presentation at the International Conference on Motion and Power Transmissions, Hiroshima, Japan, 24-26 Nov. 1991; sponsored by the Japan Society of Mechanical Engineers
(DA Proj. 1L1-62211-A-47A)
(NASA-TM-105150; E-6433; NAS 1.15:105150; AVSCOM-TR-91-C-018) Avail: NTIS HC/MF A02 CSCL 13I

An analytical method was developed to determine gear tooth surface coordinates of face milled spiral bevel gears. The method combines the basic gear design parameters with the kinematical aspects for spiral bevel gear manufacturing. A computer program was developed to calculate the surface coordinates. From this data a 3-D model for finite element analysis can be determined. Development of the modeling method and an example case are presented. Author

N91-30538*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
HIGH TEMPERATURE NASP ENGINE SEALS: A TECHNOLOGY REVIEW
Bruce M. Steinetz, Christopher DellaCorte, and Mike Tong (Sverdrup Technology, Inc., Brook Park, OH.) Aug. 1991 24 p Presented at the 10th National Aerospace Plane Technology Symposium, Monterey, CA, 23-26 Apr. 1991
(NASA-TM-104468; E-6317; NAS 1.15:104468) Avail: NTIS HC/MF A03 CSCL 11A

Progress in developing advanced high temperature engine seal concepts and related sealing technologies for advanced hypersonic engines are reviewed. Design attributes and issues requiring further development for both the ceramic wafer seal and the braided ceramic rope seal are examined. Leakage data are presented for these seals for engine simulated pressure and temperature conditions and compared to a target leakage limit. Basic elements of leakage flow models to predict leakage rates for each of these seals over the wide range of pressure and temperature conditions anticipated in the engine are also presented. Author

N91-30539*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
PM200/PS200: SELF-LUBRICATING BEARING AND SEAL MATERIALS FOR APPLICATIONS TO 900 C
Harold E. Sliney Jul. 1991 17 p Sponsored in part by DOE
Original contains color illustrations
(NASA-TM-103776; E-6043; NAS 1.15:103776) Avail: NTIS HC/MF A03; 13 functional color pages CSCL 13I

The development of the PS/PM200 class of self-lubricating material is described. The composition of the materials and their performance under temperature conditions from minus 160 degrees to 900 C (minus 250 to 1650 F) are examined. Applications in areas such as cylinder liner coatings, shaft seals, gas bearings, and airframe thermal expansion joints are proposed. Graphs and tables are provided to show service temperature limits, mechanical strength, linear thermal expansion, and thermal conductivity parameters. M.G.

N91-30540*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
THE EFFECT OF BANDWIDTH ON TELEROBOT SYSTEM PERFORMANCE
Mark Uebel, Michael S. Ali, and Ioannis Minis (Maryland Univ., College Park.) Sep. 1991 44 p
(NASA-TP-3152; Rept-91E02561; NAS 1.60:3152) Avail: NTIS HC/MF A03 CSCL 13I

The purpose of the experiment was to determine the effect that various slave-joint bandwidths have on telerobot system performance. The telerobot system consisted of a slave arm controlled by a master. The slave incorporated an impedance loop to provide local compliance in addition to the compliance provided by the operator via force feedback. Three joint bandwidths, 0.5, 1.0, and 2.0 Hz, were used. The performance measures were the task completion time and the sums of the squared forces and moments exerted on the environment. The task consisted of peg-in-hole insertion and removal. The results of the experiment indicate a significant performance decrease at 0.5-Hz bandwidth relative to the 1- and 2-Hz bandwidths. There was no significant change in performance between the 1- and 2-Hz bandwidths. Author

N91-30541 Institute for Perception RVO-TNO, Soesterberg (Netherlands). Traffic Behavior Group.
THE DEVELOPMENT OF STEERING CONTROLLABILITY TEST PROCEDURES FOR LIGHT- AND MEDIUM-WEIGHTED TRUCKS. PHASE 3: CLOSED- AND OPEN-LOOP EXPERIMENTS WITH NINE MEDIUM-WEIGHTED TRUCK CONFIGURATIONS Final Report
M. J. vanRandwijk, W. D. Kaeppler, and J. Godthelp 14 Dec. 1990 73 p
(Contract A84/KL/105)
(IZF-1990-A-44-Phase-3; TD-90-3421-Phase-3; ETN-91-99823)
Copyright Avail: Institute for Perception RVO-TNO, P.O. Box 23, 3769 ZG Soesterberg, Netherlands

A test procedure for the evaluation of vehicle handling characteristics of wheeled vehicles is developed. Both open and closed loop driving test with nine standard two axle medium weighted truck configurations (4 to 5 kN payload) are used. Subjective ratings and driver performances are gathered. The data consists of scores on three comparable principle components. By use of a multiple regression method, a significant correlation between the subjective and the objective components is established. It is concluded that: subjective ratings and driver performances are appropriate measures to discriminate controllability of vehicles; the selected open loop characteristic values are suitable to predict subjective results; and the characteristic values form a sufficient basis for future evaluation of medium weighted truck controllability. In order to reveal the relation more explicitly, it is recommended that a larger number of truck configurations be evaluated. ESA

N91-30542# National Aerospace Lab., Amsterdam (Netherlands). Space Div.
EQUIVALENT FLEXIBILITY MODELLING: A NOVEL APPROACH TOWARDS RECURSIVE SIMULATION OF FLEXIBLE SPACECRAFT-MANIPULATOR DYNAMICS
P. T. L. M. vanWoerkom 22 Aug. 1989 12 p Presented at 2nd European In-Orbit Operations Technology Symposium,

Toulouse, France, 12-14 Sep. 1989 Previously announced as N90-24316
(Contract NIVR-02506N)
(NLR-TP-89293-U; ETN-91-99645) Avail: NTIS HC/MF A03

For the simulation of rigid spacecraft manipulator dynamics there exists efficient recursive software. Extension of this software for the simulation of flexible spacecraft-manipulator dynamics would have important advantages. The method of Equivalent Flexibility Modeling (EFM) is outlined. Each flexible body is remodeled as a concatenation of rigid bodies, acted upon by fictitious loads in addition to the real loads. To calculate the fictitious loads, some modifications of the software are required. A number of tests cases are analyzed. The errors detected in these test cases are within the realm of computational inaccuracy. ESA

38 QUALITY ASSURANCE AND RELIABILITY

Includes product sampling procedures and techniques; and quality control.

N91-30543# Analytic Engineering Co., Lincoln, NE.
SURFACE ACOUSTIC WAVE TECHNIQUE FOR CRAZE DETECTION AND STRESS MEASUREMENT OF AIRCRAFT TRANSPARENCIES Final Report, Sep. 1989 - Mar. 1990
Nisar Shaikh Feb. 1991 42 p
(Contract F33615-89-C-3402)
(AD-A235943; WRDC-TR-90-3082) Avail: NTIS HC/MF A03 CSCL 11/9

A nondestructive testing technique that employs surface acoustic waves was developed for detecting and characterizing flaws and degradation in transparent enclosures of fighter aircraft. The focus of research has been acoustic measurement of craze and stresses (i.e. residual stress) in the acrylic top layer of laminated transparencies. The craze severely degrades the optical performance of the transparent enclosure and is one of the major causes of the limited service life. The stress accelerates the incipience of craze in addition to causing eventual fracture. The acoustic detection technique uses silicone rubber wedges to launch and receive surface acoustic waves. Both Rayleigh surface wave and critical angle longitudinal (L-cr) wave transducers were developed and produced favorable test results. L-cr waves are recommended for stress measurement and Rayleigh surface waves are recommended for craze detection. GRA

N91-30544# Wichita State Univ., KS. National Inst. for Aviation Research.
KQIN: KANSAS QUALITY IMPROVEMENT NETWORK. A REPORT OUTLINING A STATEWIDE QUALITY IMPROVEMENT PLAN
George Heinrich and Anne Gallagher Jul. 1991 93 p Sponsored by Kansas Technology Enterprise Corp.
(NIAR-91-20) Avail: NTIS HC/MF A05

A plan is described for the implementation of the Kansas Quality Improvement Network (KQIN). Objectives include providing a support system for business organizations initiating Total Quality Management (TQM) programs, raising the awareness of TQM and working with Kansas educational institutions to both update their curricula in the TQM area and to implement TQM techniques in their operations. The KQIN plan would allow Kansas to become more competitive with other Midwestern states that have already implemented quality improvement networks. Author

N91-30545# National Inst. of Standards and Technology, Boulder, CO. Materials Reliability Div.
MICROSTRUCTURE, COMPOSITION, AND HARDNESS OF ROCKWELL C HARDNESS BLOCKS
T. A. Siewert and A. Tomer Jan. 1991 26 p
(PB91-184747; NISTIR-3960) Avail: NTIS HC/MF A03 CSCL 14D

The microstructure, composition, and hardness of hardness blocks (Rockwell C scale) that are commonly available in the country were examined. Blocks near HRC levels of 25, 45, and 65 were obtained from each of six sources to represent the HRC measurement range. It was found that the steels used in the blocks had surprisingly high levels of impurity elements, which are one source of scatter in the hardness values. Other than the concern for the steel purity, it is concluded that most of these hardness block producers possess the technology necessary to manufacture a reference hardness block, or series of blocks, if it is found desirable for NIST to distribute a national hardness standard. Author

N91-30546*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
ULTRASONIC VELOCITY TECHNIQUE FOR MONITORING PROPERTY CHANGES IN FIBER-REINFORCED CERAMIC MATRIX COMPOSITES
Harold E. Kautz and Ramakrishna T. Bhatt 1991 12 p Presented at the 15th Annual Conference on Composites and Advanced Ceramics, Cocoa Beach, FL, 13-16 Jan. 1991; sponsored by the American Ceramic Society
(DA Proj. 1L1-61102-AH-45)
(NASA-TM-103806; E-5926; NAS 1.15:103806; AVSCOM-TR-91-C-017) Avail: NTIS HC/MF A03 CSCL 14D

A technique for measuring ultrasonic velocity was used to monitor changes that occur during processing and heat treatment of a SiC/RBSM composite. Results indicated that correlations exist between the ultrasonic velocity data and elastic modulus and interfacial shear strength data determined from mechanical tests. The ultrasonic velocity data can differentiate strength. The advantages and potential of this nondestructive evaluation method for fiber reinforced ceramic matrix composite applications are discussed. Author

N91-30547# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Materials and Processes Div.
HIGH-RELIABILITY SOLDERING FOR SURFACE-MOUNT AND MIXED-TECHNOLOGY PRINTED-CIRCUIT BOARDS
Mar. 1991 80 p
(ESA-PSS-01-738-Issue-1; ISSN-0379-4059; ETN-91-99829)
Copyright Avail: NTIS HC/MF A05

The rigorous standards set by this specification ensure the high reliability of soldered electrical connections to surface mounted devices intended to withstand normal terrestrial conditions and the vibrational G loads and environment imposed by space flight. The proper tools, correct materials and rejection criteria are stated and some workmanship standards are included to permit discrimination between proper and improper work. ESA

N91-30548# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.).
AUTOMATIZED ULTRASONIC EXAMINATION OF COPPER FORGING BLANKS FOR THE ARIANE DRIVING GEAR [AUTOMATISIERTE ULTRASCHALLPRUEFUNG AN KUPFERSCHMIEDEROHLINGEN FUER DAS ARIANE-TRIEBWERK]
R. Bilgram and A. Gessler 1990 10 p In GERMAN Presented at Jahrestagung Zerstoerungsfreie Materialpruefung, Trier, Fed. Republic of Germany, 21-23 May 1990
(MBB-Z-0327-90-PUB; OTN-030841; ETN-91-99455) Avail: NTIS HC/MF A02

An automatically working ultrasonic testing system is presented, which is suitable for recording and detecting blowholes and inclusions in the wall of the rotational symmetrical forging blanks of the combustion chamber of the main driving gear of ARIANE 5, and also for evaluating depth situation and size. The inspection requires primarily the coverage of the complete A images which are searched on line, line by line according to relevant error indications. The detailed evaluation of the remaining indications occurs off line with proper decision criteria and peak analysis techniques. Correlations by parallel examination in contact and dipping technique and destructive analysis were performed for size evaluation. ESA

39 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance.*

N91-30549# Army Engineer Waterways Experiment Station, Vicksburg, MS. Structures Lab.
RESPONSE LIMITS OF BLAST-RESISTANT SLABS Final Technical Report
Stanley C. Woodson Oct. 1990 96 p
(AD-A229338; WES/TR/SL-90-11) Avail: NTIS HC/MF A05
CSCL 13/13

The use of some type of shear reinforcement (lacing bars or stirrups) is required by current manuals for blast resistant design. The primary purpose of this reinforcement is not to resist shear stresses, but rather to improve performance in the large deflection region by tying the two principal reinforcement mats together. The shear reinforcement design criteria of the current design manuals, particularly the widely used Draft TM 5-1300, appear to be overly conservative. The design criteria are based on an incomplete test series. Recent tests indicate that slabs with stirrups can sustain support rotations significantly larger than allowed by the manual. If overly conservative design criteria are eliminated, the structures can be designed with more confidence and constructed more economically than current procedures allow. Suggestions for new design guidelines are presented. Further testing and/or analyses are needed to allow validation or modification of the suggested revisions. These guidelines are primarily based on response limits. An analytical procedure for more accurately determining shear reinforcement requirements is needed. GRA

N91-30550# CASDE Corp., Arlington, VA.
INELASTIC DEFORMATION OF PLATE PANELS Final Report
Eric Jennings, Kim Grubbs, Charles Zanis, and Louis Raymond
Jan. 1991 184 p
(Contract DTCG23-88-C-20030)
(AD-A236662; SSC-364; SR-1322) Avail: NTIS HC/MF A09
CSCL 13/10

Ship plate panel often experience inelastic deformation due to loads normal to their surface such as ice pressure, green water, slamming, docking, wheel loads and low energy collision. However, criteria for assessing the need to repair panels deformed in-service are not readily available. Design guidelines are available that restrict the allowable levels of inelastic deformation in new construction. This report presents the results of an experimental and analytical investigation related to establishing criteria for assessing the amount of plastic deformation that may be permitted on existing ship structures without compromising structural integrity. The work included the review of existing criteria for panel deformation, measurement of plate panel deformation on existing ships, finite element analysis to establish strain vs. deflection relationships for ship plate panels, and an assessment of the efforts, a methodology is proposed for determining the maximum inelastic deformation that should be permitted for ship steel structural panels. GRA

N91-30551 Virginia Polytechnic Inst. and State Univ., Blacksburg.
A THEORETICAL AND EXPERIMENTAL STUDY OF MODAL INTERACTIONS IN RESONANTLY FORCED STRUCTURES Ph.D. Thesis
Balakumar Balachandran 1990 308 p
Avail: Univ. Microfilms Order No. DA9116622

The influence of modal interactions on the response of harmonically excited flexible L-shaped metallic and composite structures was investigated analytically and experimentally. Each metallic structure possesses a two-to-one internal resonance, while each composite structure possesses a three-to-one internal resonance and either a two-to-one or a one-to-one internal resonance. For the metallic structures, a weakly nonlinear analysis is used to derive the autonomous system of equations which describe the evolution of the amplitudes and phases of the internally resonant modes. These equations are obtained for primary-and secondary-resonant excitations. The excitation frequency or amplitude is used as a control parameter and the resulting bifurcations are studied. Theoretical analyses for internally resonant systems are used to predict and explain the responses of the composite structures. In the experiments, during primary-resonant excitations, low excitation (mili g) levels are used, while during secondary-resonant excitations, high excitation (one to two g) levels are used. The experimental observations made during secondary resonant excitations, high excitation (one to two g) levels are used. The experimental observations made during secondary-resonant excitations are in good agreement with the analytical predictions. Analytical approximations for representative third-order and fourth-order autonomous systems are derived to study motions near the Hopf-bifurcation points of each of these systems. Dissert. Abstr.

N91-30552 Stanford Univ., CA.
PROBABILISTIC FINITE ELEMENT METHODS FOR PROBLEMS IN SOLID MECHANICS Ph.D. Thesis
Joao Luis deBarros Dias 1991 220 p
Avail: Univ. Microfilms Order No. DA9115760

A general strategy for the development of probabilistic finite element methods in solid mechanics is presented. Discretization techniques based on finite element shape functions and the spectral decomposition theorem are used to describe continuous fields of correlated random variables. Existing methods for the solution of stochastic problems are surveyed, with particular emphasis on the sampling patterns employed by these methods. An efficient family of iterative perturbation algorithms is proposed in order to reduce the cost of computing the finite element solutions at these sampling points. The iterative perturbation algorithms are residual driven, do not involve explicit derivatives of the stiffness equations, and are easily extended to problems where the unperturbed solution is also obtained by an iterative strategy. The combination of an efficient sampling strategy with a robust perturbation more accurately represent the underlying mechanics of the problem. Applications to both linear and nonlinear probabilistic finite element problems in solid mechanics are discussed with the aid of numerical examples. Dissert. Abstr.

N91-30553 Washington Univ., Saint Louis, MO.
GEOMETRICALLY NONLINEAR ANALYSIS WITH THE p-VERSION OF THE FINITE ELEMENT METHOD Ph.D. Thesis
John Edward Schiermeier 1990 158 p
Avail: Univ. Microfilms Order No. DA9114721

The purpose is to develop methods of using p-version elements in geometrically nonlinear problems involving small strains and large displacements. A hierarchic sequence of shell models is presented, and is first explained in relation to classical shell models. The three-dimensional elasticity equations are presented, and then the principle of virtual work is used to formulate the finite element solution with the assumptions of linear strain-displacement relations and a linear constitutive law. The mapping and basis functions are described in detail for the hexahedral and quadrilateral elements. These basis functions are the key to the hierarchic sequence. Construction of the element stiffness matrices and load vectors and computation of the post-processing quantities are explained. In addition, a method of computing the stress resultants based on the principle of virtual work is developed. The lowest level of the hierarchic model is used to solve the linear problem of a spherical shell with edge ring, for which the stress resultants are computed using two different methods and compared to the highest level of the hierarchic model. Dissert. Abstr.

N91-30554 Virginia Polytechnic Inst. and State Univ., Blacksburg.
APPLICATION OF LOCALIZED HYBRID METHODS OF STRESS ANALYSIS TO SOME PROBLEMS IN THE MECHANICS OF COMPOSITES Ph.D. Thesis
Ming-Yi Tsai 1990 139 p
Avail: Univ. Microfilms Order No. DA9116652

A new method of stress analysis which combines an

experimental technique, moire interferometry, and a numerical method, finite element analysis, is presented. In this localized hybrid method, the displacement fields which the moire experiments provide in some local regions of interest are used as input data for finite element stress analyses. Two important and controversial problems in the mechanics of composites are investigated using the localized hybrid method. One is a thermally loaded bimetal plate, and the other involves the Iosipescu shear specimen popularly used to determine the shear modulus and strength of a fiber reinforced composite. Before applying the localized hybrid analysis, the mechanics of the problems are discussed individually, through a numerical study and strength of materials analysis. Based on these fundamental studies, the localized hybrid method is applied to stress or strain analyses of moire experimental results, and special techniques of this method are developed to handle these data. For the thermally loaded plate, several finite element models, simulating 2-D and 3-D mechanics, are used to assess the stress state at the interface near the free surface, and identify a boundary layer. It is shown that high gradients and stress turnaround are documented in stress components normal to the interface, along the surface line crossing the interface, and a boundary layer is identified in the small region near the interface around the free surfaces. These observations are also confirmed by the hybrid analysis of moire experimental results. However, additional variations of the localized hybrid method were needed to capture the three-dimensional nature of the problem. A comparison of numerical results with experimental data resolved an apparent anomaly between experiments and mechanics principles. For the Iosipescu shear specimen, the 3-D mechanics associated with twisting is proposed for accounting for the inconsistent and variable results in the literatures. The results from the localized hybrid analysis indicate that uniformity and purity of shear stress state in the test section cannot be accomplished for each fiber orientation specimens; the 0 degrees specimens suffer from a load proximity effect, the 90 degrees specimens are affected by apparent in- and out-plane bending, and the 0 degrees/90 degrees specimens are midway between those. Dissert. Abstr.

N91-30555 Nottingham Univ. (England).
THE PREDICTION OF STRESS INTENSITY FACTORS BY THREE-DIMENSIONAL PHOTOELASTICITY Ph.D. Thesis
N. A. Warrior 1990 195 p
Avail: Univ. Microfilms Order No. BRD-92001

In order to predict the failure loads or fatigue crack growth rates in cracked engineering components, it is necessary to have an accurate technique for determining stress intensity factors under mixed-mode loading conditions. An accurate photoelastic method is presented, and has been used to give results for semi-circular surface cracks in plates, blocks and internally pressurized thin cylinders. The cracks are inclined to the principal stress axes, resulting in mixed-mode behavior. Traditionally, photoelastic stress intensity factors are determined by comparing the observed maximum in-plane shear stress pattern ahead of a manufactured crack with the crack-tip stresses predicted by a truncated series derived from the Westergaard stress function. The existing methods have been classified as individual loop methods, selected region methods and full-field methods, according to data requirements. Seven published methods (covering all three classifications) have been assessed by comparing results with existing solutions. The individual loop methods generally give relatively poor results, and should not be used in three-dimensional analyses. The selected data and full-field methods can give accurate results, but the truncated equations significantly misrepresent regions of the stress field, even close to the crack tip, when an appreciable shear, or far-field stress component is present. For practical three-dimensional photoelastic models the crack-tip position is ill-defined. It is shown that an optimum position exists where the origin of the experimental crack-tip stress field coincides with the origin of the Westergaard stress function. The change of optimum position with varying mode mixity is demonstrated for practical crack-like flaws. A new method, for prediction of mixed-mode stress intensity factors, based on the Multiple Points Over-deterministic Method, and incorporating a full expansion of the crack-tip stress series due to Westergaard and an optimum crack-tip location routine is introduced, and accuracies for practical notch type geometries are presented. Stress intensity factors for a range of geometries are calculated using the new method. Dissert. Abstr.

N91-30556 Michigan Univ., Ann Arbor.
STABILITY OF THERMOELASTIC CONTACT Ph.D. Thesis
Ronggang Zhang 1990 134 p
Avail: Univ. Microfilms Order No. DA9116338

When heat is conducted across an interface between two different materials, the interaction between thermoelastic distortion and thermal contact resistance can cause the system to behave in many interesting ways, one of them being the non-existence of steady-state solution if idealized boundary conditions are applied. Attempts to overcome this difficulty prompted the assumption of a pressure or gap dependent thermal resistance across the interface. However, multiple solutions are still possible with such more realistic boundary conditions. The scope of investigations on uniqueness and stability of solutions to physically more complex thermoelastic contact systems is extended. For the simple one-dimensional model, it is found that there is a range of conditions under which the steady-state solution is unique but unstable. A numerical study shows that under such conditions the system always tends to a steady oscillatory state. These conclusions have important implications for the classical steady-state solutions to two- and three-dimensional thermoelastic contact problems. Since the uniqueness of such solutions cannot now be regarded as a guarantee of stability, their stability needs to be reexamined. In particular, the possibility that a steady oscillatory state exists must be accepted. To verify these predictions, a two-dimensional system was examined with particular attention on the influence of material properties on the stability criterion. A numerical method is then developed to study the long term behavior of such a system in detail. The results confirm the criterion developed in the analysis of the two half-plane system. Results have also reaffirmed some of the previously known behavior classes, but also exposed a new kind: when heat flows into the less distortive material, the transient solution can tend to a state in which a disturbance with contact and separation regions travels along the interface at constant speed while retaining the same form. Dissert. Abstr.

N91-30557 Lancaster Univ. (England).
FULL-RANGE AXISYMMETRIC ELASTOPLASTIC LARGE DEFLECTION OF CIRCULAR AND ANNULAR PLATES UNDER TRANSVERSE, IN-PLANE AND COMBINED LOADING Ph.D. Thesis
Hayat Drinali 1989 404 p
Avail: Univ. Microfilms Order No. BRDX91865

The problem to be considered is the large deflection analysis of a circular or annular plate subjected to either a uniformly distributed load applied to the upper face or an in-place compressive or tensile force applied at the boundary edges or a combination of both loadings. The first yield load and the maximum load carrying capacity of the plate is of major interest. However, the response of the place to increasing incremental load and the effects of varying imperfection magnitudes as well as strain hardening and orthotropy are investigated. Parameter studies including deflection, stress couples and stress resultants in the radial and tangential directions are obtained for various boundary conditions, initial deflection amplitudes, slenderness and hole size ratios. Elastic and elasto-plastic parametric studies considering both bending and buckling problems are carried out, the elasto-plastic analysis including both first yield and full-range responses of circular and annular plates. Then transverse and in-plane combined loading first yield and full-range results of circular plates are obtained. Comparison of these DR results with those obtained by different methods is carried out. The theory developed relates to two formulations. The first uses an approximate yield criterion given by Ilyushin which relates to the stress resultants. This yield criterion which assumes a sudden plastification of the plate section is referred to as the full-section approach. The second method involves a volume integral and is based on Von Mises yield criterion. This method is referred to as the layer approach. Finally, circular

plate design examples are presented to illustrate the application of the design data relating to nonlinear first yield design of edge compressed circular plates and the collapse behavior of plates subjected to combined transverse pressure and uniform edge compression. Dissert. Abstr.

N91-30558 Southampton Univ. (England).
WAVE PROPAGATION IN PERIODICALLY STIFFENED PLATES AND SHELLS Ph.D. Thesis
Nicholas Simon Bardell 1990 331 p
Avail: Univ. Microfilms Order No. BRDX92315

It is investigated how the vibration-transmission characteristics of periodically stiffened plates and shells might be exploited to reduce propfan-induced noise and vibration in the fuselage cabins of civil aircraft. Initially, steady state harmonic wave propagation is considered in stringer-stiffened and frame-stiffened cylinders. Generality of stringer and frame section is allowed. Both types of structure are analyzed as one-dimensional periodic systems. Exact, closed-form relationships are established between the frequency and the propagation constants. Computed values are presented in graphical form, and clearly show the existence of distinct frequency stop and pass bands. The phase constant part of these curves is used to deduce the natural frequencies and normal modes for a number of specific structures. Provision is made for the inclusion of hysteretic damping. Steady state harmonic wave propagation is then considered in orthogonally stiffened plates and shells. Although the vibration modes and waves of these structures do not admit closed-form, exact solutions, approximate modes and frequencies can be deduced using energy methods. Both types of structure are therefore analyzed as two-dimensional periodic systems by using wave propagation techniques in conjunction with the hierarchical finite element method. Results are presented in the form of phase constant surfaces plotted against frequency. Experimental work conducted on two differently stiffened cylinders provides additional substantiation to the theoretical analyses. Dissert. Abstr.

N91-30559 Virginia Polytechnic Inst. and State Univ., Blacksburg.
DEVELOPMENT OF ADVANCED MODAL METHODS FOR CALCULATING TRANSIENT THERMAL AND STRUCTURAL RESPONSE Ph.D. Thesis
Charles J. Camarda 1990 118 p
Avail: Univ. Microfilms Order No. DA9116624

Higher-order modal methods were evaluated for predicting thermal and structural response. A unified method is presented for deriving successively higher-order modal solutions related to previously-developed, lower-order methods such as the mode-displacement and mode-acceleration methods. A new method, called the force-derivative method, is used to obtain higher-order modal solutions for both uncoupled (proportionally-damped) structural problems as well as thermal problems and coupled (non-proportionally damped) structural problems. The accuracy and convergence history of various modal methods are compared for several example problems, both structural and thermal. The higher-order modal methods are shown to converge to an accurate response using fewer eigenmodes than lower-order modal methods. The force-derivative method is very effective in representing the response of the important, but otherwise neglected, higher modes for structural problems in which there are a large number of closely-spaced frequencies.
Dissert. Abstr.

N91-30560 Glasgow Univ. (Scotland).
THE ELASTOPLASTIC BUCKLING STRENGTH OF IMPERFECT HEMISPHERES AND THEIR RELIABILITY Ph.D. Thesis
Wen Jiao Shao 1985 229 p
Avail: Univ. Microfilms Order No. BRDX91912

Safety levels for slender and stocky hemispheres are not the same when a constant safety factor approach, as in BS5500, is used in their design. This contrasts with the trends apparent in numerical results of the effect of geometric distortions on the strength of hemispheres. It seems feasible to derive a formula for the buckling strength of hemispheres which can express the varying influences on the buckling strength of slenderness and deformation amplitude. Dynamic Relaxation (DR) in conjunction with central finite differences is used to numerically solve the doubly-curved thin shell equations and a multi-layer approach based upon the von Mises yield criterion in conjunction with the Prandtl-Reuss flow rule and Whang's technique is used for behavior in the plastic region. The extension of DR to the solution of nonlinear dynamic response analysis in real time is developed. Two strength formulae based upon the results of the parametric studies are derived using modified linear regression. By comparing the results derived from the analysis with experimental data, a formula is derived for predicting the mean of this data based on a slenderness-dependent equation for initial deformation magnitude. It is necessary to propose a procedure for estimating the statistical parameters for initial deformation amplitude. One is advanced, based on using linear error theory and the information relating to well-documented tests on externally pressurized model spheres. Using these design strength formulae in conjunction with an advanced Level 2 method, the reliability of imperfect hemispheres is examined.
Dissert. Abstr.

N91-30561 State Univ. of New York at Buffalo, Amherst.
NONLINEAR EFFECTS IN THERMALLY AND MECHANICALLY INDUCED MOTION OF ELASTIC SOLIDS Ph.D. Thesis
Yoocheol Woo 1990 168 p
Avail: Univ. Microfilms Order No. DA9115151

The thermally and mechanically induced motion of hyperelastic solids is studied. The analysis is based on a linear constitutive law between second Piola-Kirchhoff stress tensor and Lagrangian strain tensor. However, boundary constraints preventing horizontal movement can render the ensuing motion highly nonlinear. Internal stresses, which are induced by the constraints upon expansion for thermally loaded case and/or by coupling between bending and stretching, have a pronounced effect on the stiffness of the structure. The method of solution of solids characterized by certain nonlinear, temperature dependent constitutive laws is applied to the case of beams, plates, and 3-D solids. These structures are subjected to time dependent heat input or transverse surface loads, and the dynamic responses are found for a constrained boundary case. The comparison with the corresponding unrestrained case is presented, and thermally and mechanically induced motion of the solids is discussed. Dissert. Abstr.

N91-30562*# Sverdrup Technology, Inc., Brook Park, OH.
ASTROP3 USER'S GUIDE Final Report
Richard August Aug. 1991 34 p
(Contract NAS3-25266)
(NASA-CR-187180; E-6477; NAS 1.26:187180) Avail: NTIS HC/MF A03 CSCL 20K

ASTROP3 (Aeroelastic Stability and Response of Propulsion Systems) is a FORTRAN computer code developed for calculating the performance and dynamic stability (classical flutter) of single rotation propfans. Three-dimensional, subsonic aerodynamics with constant pressure panel discretization and MSC/NASTRAN finite element analysis of the blade are used to calculate the steady and unsteady aerodynamic forces. The flutter analysis is a modal based technique using motion dependent aerodynamic forces based on in-vacuum frequencies and normal modes of the individual propfan blades. The execution of ASTROP3 is illustrated through the calculation of blade performance and blade aeroelastic stability for the SR7L rotor. These calculations are representative of applications for ASTROP3. All input and output files necessary for program execution are discussed, as well as other appropriate information to aid the user in applying the program. Author

N91-30563*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Facility, Edwards, CA.
COMBINED-LOAD BUCKLING BEHAVIOR OF METAL-MATRIX COMPOSITE SANDWICH PANELS UNDER DIFFERENT THERMAL ENVIRONMENTS
William L. Ko and Raymond H. Jackson Sep. 1991 27 p

(NASA-TM-4321; H-1714; NAS 1.15:4321) Avail: NTIS HC/MF A03 CSCL 20K

Combined compressive and shear buckling analysis was conducted on flat rectangular sandwich panels with the consideration of transverse shear effects of the core. The sandwich panel is fabricated with titanium honeycomb core and laminated metal matrix composite face sheets. The results show that the square panel has the highest combined load buckling strength, and that the buckling strength decreases sharply with the increases of both temperature and panel aspect ratio. The effect of layup (fiber orientation) on the buckling strength of the panels was studied in detail. The metal matrix composite sandwich panel was much more efficient than the sandwich panel with nonreinforced face sheets and had the same specific weight. Author

N91-30564 Royal Military Coll. of Canada, Kingston (Ontario).
DEVELOPMENT OF STRUCTURAL OPTIMIZATION CAPABILITY AT RMC
C. T. Shyu, N. K. Pope, and J. S. Ellis 31 Mar. 1989 257 p
(Contract DREA-FE-311F121)
(DREA-CR-89-413; CTN-91-60194) Avail: NTIS HC A12

This report describes the implementation, on the Royal Military College (RMC) Honeywell Computer, of the constrained structural optimization programming systems PROSS, PROSS-2, and PVC04. PROSS and PROSS-2 were developed at the NASA Langley Research Center by combining in a modular manner a production level structural analysis program (SPAR), a state-of-the-art optimization program (CONMIN) and user supplied and problem dependent interface programs. PVC04 was developed at RMC by replacing, in PROSS-2, SPAR by the Defence Research Establishment Atlantic sponsored vibration and strength analysis program VAST04. During the implementation of the three programming systems, code for many component parts was converted from CDC and VAX systems to run on the RMC Honeywell system. Test runs were made in order to ensure that the converted component parts were functioning correctly. Finite element models of a fuselage, a 35 member latticed frame and two stiffened cylinders were used as test or demonstration problems for the three constrained optimization programs. All the problems involved weight minimization. Up to 16 design variables were used and up to four types of constraint were considered. Reasonable solutions were obtained for all constrained optimization problems attempted. The report contains a user's manual which describes in detail the minimization of the weight of a constrained latticed frame structure. Author (CISTI)

N91-30565*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
STRUCTURAL DESIGN CONCEPTS FOR A MULTI-MEGAWATT SOLAR ELECTRIC PROPULSION (SEP) SPACECRAFT
Charles Lawrence and J. Mark Hickman Aug. 1991 19 p
(NASA-TM-105148; NAS 1.15:105148) Avail: NTIS HC/MF A03 CSCL 20K

As a part of the Space Exploratory Initiative (SEI), NASA-Lewis is studying Solar Electric Propulsion (SEP) spacecraft to be used as a cargo transport vehicle to Mars. Two preliminary structural design concepts are offered for SEP spacecraft: a split blanket array configuration, and a ring structure. The split blanket configuration is an expansion of the photovoltaic solar array design proposed for Space Station Freedom and consists of eight independent solar blankets stretched and supported from a central mast. The ring structural concept is a circular design with the solar blanket stretched inside a ring. This concept uses a central mast with guy wires to provide additional support to the ring. The two design concepts are presented, then compared by performing stability, normal modes, and forced response analyses for varying levels of blanket and guy wire preloads. The ring structure configuration is shown to be advantageous because it is much stiffer, more stable, and deflects less under loading than the split blanket concept. Author

N91-30566*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
FATIGUE BEHAVIOR AND LIFE PREDICTION OF A SiC/Ti-24Al-11Nb COMPOSITE UNDER ISOTHERMAL CONDITIONS Ph.D. Thesis
Paul A. Bartolotta Aug. 1991 141 p
(NASA-TM-105168; E-6459; NAS 1.15:105168) Avail: NTIS HC/MF A07 CSCL 20K

Metal Matrix Composites (MMC) and Intermetallic Matrix Composites (IMC) were identified as potential material candidates for advanced aerospace applications. They are especially attractive for high temperature applications which require a low density material that maintains its structural integrity at elevated temperatures. High temperature fatigue resistance plays an important role in determining the structural integrity of the material. This study attempts to examine the relevance of test techniques, failure criterion, and life prediction as they pertain to an IMC material, specifically, unidirectional SiC fiber reinforced titanium aluminide. A series of strain and load controlled fatigue tests were conducted on unidirectional SiC/Ti-24Al-11Nb composite at 425 and 815 C. Several damage mechanism regimes were identified by using a strain-based representation of the data, Talreja's fatigue life diagram concept. Results of these tests were then used to address issues of test control modes, definition of failure, and testing techniques. Finally, a strain-based life prediction method was proposed for an IMC under tensile cyclic loadings at elevated temperatures. Author

N91-30567*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
DAMAGE PREDICTION IN CROSS-PLIED CURVED COMPOSITE LAMINATES
Roderick H. Martin (Analytical Services and Materials, Inc., Hampton, VA.) and Wade C. Jackson Jul. 1991 54 p
(NASA-TM-104089; NAS 1.15:104089; AVSCOM-TR-91-B-009)
Avail: NTIS HC/MF A04 CSCL 20K

Analytical and experimental work is detailed which is required to predict delamination onset and growth in a curved cross plied composite laminate subjected to static and fatigue loads. The composite used was AS4/3501/6, graphite/epoxy. Analytically, a closed form stress analysis and 2-D and 3-D finite element analyses were conducted to determine the stress distribution in an undamaged curved laminate. The finite element analysis was also used to determine values of strain energy release rate at a delamination emanating from a matrix crack in a 90 deg ply. Experimentally, transverse tensile strength and fatigue life were determined from flat 90 deg coupons. The interlaminar tensile strength and fatigue life were determined from double cantilevered beam specimens. Cross plied curved laminates were tested statically and in fatigue to give a comparison to the analytical predictions. A comparison of the fracture mechanics life prediction technique and the strength based prediction technique is given.
Author

N91-30568# Southampton Univ. (England). Inst. of Sound and Vibration Research.
A STUDY OF THE VIBRATIONAL POWER INPUT TO BEAM-LIKE STRUCTURES SUBJECTED TO SIMULTANEOUSLY ACTING FORCE AND MOMENT EXCITATIONS
Y. K. Koh Aug. 1990 65 p Sponsored by Ministry of Defence
(ISVR-TR-190; ETN-91-99781) Avail: NTIS HC/MF A04

Results of a theoretical investigation of the time averaged vibrational power input to beam-like structures are presented. The structures are subjected to simultaneously acting force and moment excitations and potential vibration control schemes, both active and passive, based on the properties of the driving point mobility matrix and the strength of the force and moment excitations. Theoretical expressions for the driving point mobility matrix of a semi-infinite beam and finite beams with different boundary support conditions are derived. ESA

N91-30569# Royal Aerospace Establishment, Farnborough (England).
FRAG REQUIREMENTS FOR CONTROL OF FATIGUE TESTING: SECOND ISSUE
R. Cook 21 Feb. 1991 36 p
(AD-A211768; RAE-TM-Mat/Str-1130; BR300700; ETN-91-99857)
Copyright Avail: NTIS HC/MF A03

The findings of a working party formed by the Fatigue Research Advisory Group (FRAG) are described. The accuracy requirements of load application, calibration requirements and test data that must be recorded are defined. Various methods of control are described which may be used to achieve the testing accuracy requirements. The requirements are applicable to both fatigue testing machines and single actuator test rigs, used to generate materials data and to test simple coupons. ESA

N91-30570# Technische Univ., Berlin (Germany, F.R.). Inst. fuer Luft- und Raumfahrt.
A FINITE ELEMENT PROCESS FOR THE EXAMINATION OF WAVE DISPERSION IN INFINITELY LONG BEAMS Thesis [EIN FINITE-ELEMENTE-VERFAHREN ZUR UNTERSUCHUNG DER WELLENAUSBREITUNG IN UNENDLICH LANGEN TRAEGERN]
Kai Willner Feb. 1991 46 p In GERMAN
(ILR-Mitt-255(1991); ETN-91-99463) Avail: NTIS HC/MF A03

The process presented of harmonic continuations allows self oscillation behavior of any infinitely extended, continuous structure to be understood using a conventional finite element model. The difficulties occurring when using more than one element in longitudinal direction are indicated, without giving a plausible explanation. A UIC 60 rail was chosen as an example of structure. The dispersion relations were obtained for this rail. They were compared with other process results. An agreement was obtained with experiment results. It was also shown that a simplified double girder model is suitable for the examination of frequencies inferior to 3 kHz. A simple plate model is suitable for most proper forms in a frequency zone up to 16 kHz. ESA

N91-30571# Aeronautical Research Inst. of Sweden, Stockholm. Structures Dept.
THEORY AND COMPUTATIONS OF THE STEADY STATE HARMONIC RESPONSE OF VISCOELASTIC RUBBER PARTS
Adam Zdunek Jun. 1990 38 p
(Contract STU-84-3086)
(FFA-TN-1988-34; ETN-91-99545) Avail: NTIS HC/MF A03

A robust finite element method for the determination of the static response and the response due to small harmonic excitations superposed on a prestrained equilibrium state, is presented for rubber engineering applications. The method presented here is based on a Key type variational formulation, for a nearly incompressible rubber-elasticity problem. The problems originating from the difficulty in approximating the accumulated pressure, common to several popular nonlinear single field strain projection methods, are removed. The remedy is to treat the accumulated pressure as a separate solution variable. The rubber-elastic description is extended to include a form of deviatoric viscoelasticity. A popular time/strain separable simplified form of the relaxation modulus tensor is used in the linearized incremental constitutive equation. A weak formulation for the harmonic response problem is made in the complex domain. Use of the local element wise pressure approximation admits elimination of pressure increments. ESA

N91-30572# Aeronautical Research Inst. of Sweden, Stockholm. Structures Dept.
TESTING LAMINATED SWEDISH FIR IN FOUR POINT BENDING
Maria Poppen Apr. 1991 19 p Sponsored by Swedish National Energy Administration
(FFA-TN-1991-15; ETN-91-99547) Avail: NTIS HC/MF A03

Laminated Swedish fir has been tested in four point bending. Three different types of specimens were manufactured, one with scarf joints on the outer layers, one with glass fiber weave in between the layers and one with continuous veneers. The three different types of specimens were tested statically to determine the modulus of elasticity and the static strength. Fatigue tests were performed with constant amplitude loading and with spectrum loading in the form of the standardized load sequence WISPER. For a small number of specimens, the decrease in stiffness was monitored. The importance of accounting for the existence of joints and other deviations from a perfect material state when deciding the design limits for structural components are shown. Even if the scarf joints have a slope of 1:15, which is supposed to be perfect joints, the influence is not negligeable. ESA

N91-30573# National Aerospace Lab., Amsterdam (Netherlands). Structures and Materials Div.
THE STATIC STRENGTH OF MECHANICALLY FASTENED CARBON-EPOXY JOINTS WITHOUT BENDING
J. Lameris and P. Minderhoud 16 Jan. 1989 98 p
(Contract OV/RLD-836)
(NLR-TP-89019-U; GARTEUR/TP058-2; ETN-91-99631) Avail: NTIS HC/MF A05

The mechanical behavior of mechanically fastened double lap carbon epoxy joints were investigated both by experiments (static tests) and by analysis. Several fastener types and joint geometries were investigated. In the experimental program the Fibredux 6376/T400H lateral was used. Two methods to analyze mechanically fastened composite joints are described: a semi-analytical method in which Nuismer's point failure criterion is applied to an analytically determined stress distribution and a finite element based computer program BOLT. A good agreement between test and analysis was found. ESA

42 GEOSCIENCES (GENERAL)

No abstracts in this category.

43 EARTH RESOURCES AND REMOTE SENSING

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.

For instrumentation see *35 Instrumentation and Photography.*

N91-30574# Naval Oceanographic and Atmospheric Research Lab., Bay Saint Louis, MS.
ALTIMETER SEA ICE WORKSHOP
Jeffrey D. Hawkins Sep. 1990 29 p Workshop held in Bay Saint Louis, MS, 15-16 Feb. 1990
(AD-A229396; NOARL-SP-059-321-90) Avail: NTIS HC/MF A03 CSCL 08/12

NOARL's Remote Sensing Branch successfully carried out a demonstration program aimed at extracting sea ice formation from the Geosat altimeter signal. This effort significantly enhanced earlier limited studies done with the GOES-3 altimeter by incorporating the Automated Gain Control (AGC) and the Voltage Proportional to Attitude (VATT) parameters carried in the real-time data stream. These measures of the return pulse were combined in a ratio form to create an ice index, so that all values less than a cutoff magnitude were characteristics of open water, while all remaining values above were sea ice. The altimeter footprint varies in size, depending on the surface roughness. In extremely smooth cases, the surface area in less than 1 km; in rough examples, it may be 5 to 7 km in areal extent. So, unless the altimeter footprint is fortuitously sampling a location where only one surface type is present (open water, first-year FY ice, multiyear MY ice, etc.), the altimeter waveform will be a mixture of returns from two or more surface types. In general, excellent results were achieved. Sea

ice concentrations by ice type over the experiment area agreed with the surface truth to within 5 percent. When FY (first year) and MY (multiyear) ice types were combined to give total ice concentration, the agreement was within 2 percent. Thus, linear unmixing has been shown to be a useful paradigm for extracting ice information from waveform shapes. However, this approach needs further investigation. GRA

N91-30575# Office of Technology Assessment, Washington, DC.
VERIFICATION TECHNOLOGIES: COOPERATIVE AERIAL SURVEILLANCE IN INTERNATIONAL AGREEMENTS
Jul. 1991 123 p
(OTA-ISC-480) Avail: NTIS HC/MF A06; also available SOD HC $5.50 as 052-003-01248-1

This report examines the potential and limitations of cooperative aerial surveillance as a means of supporting the goals of a variety of international agreements. It surveys the types of aircraft and sensors that might be used. It reviews the status of and issues raised by the Open Skies Treaty negotiations as an extended example of an aerial surveillance regime. The report concludes with a quantitative analysis of one possible use of cooperative overflights: the search for potential arms control violations. Author

N91-30576# National Oceanic and Atmospheric Administration, Washington, DC. Office of Satellite Data Processing and Distribution.
SATELLITE OBSERVATION OF GREAT LAKES ICE: WINTER 1986-1987
Sharolyn L. Young Jul. 1991 38 p
(NOAA-NESDIS-34) Avail: NTIS HC/MF A03

A descriptive view is given of the ice season along with analyzed charts derived from various data sources. During the ice season, ice conditions on the Great Lakes and Lake St. Clair were monitored using satellite imagery. The formation, movement, decay, and dissipation of the lake ice was observed from December 1986 through April 1987. Air temperatures were a contributing factor to ice formation and decay. Wind speeds and directions were a factor in ice movement and dissipation. Author

N91-30577*# Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
DESIGN OF THE PRIMARY AND SECONDARY PRE-TRMM AND TRMM GROUND TRUTH SITES Final Report, 16 Mar. 1990 - 30 Jun. 1991
Michael Garstang, Geoffrey Austin, and Claire Cosgrove 9 Aug. 1991 143 p
(Grant NAG5-870)
(NASA-CR-188755; NAS 1.26:188755) Avail: NTIS HC/MF A07 CSCL 08B

Results generated over six months are covered in five manuscripts: (1) estimates of rain volume over the Peninsula of Florida during the summer season based upon the Manually Digitized Radar data; (2) the diurnal characteristics of rainfall over Florida and over the near shore waters; (3) convective rainfall as measured over the east coast of central Florida; (4) the spatial and temporal variability of rainfall over Florida; and (5) comparisons between the land based radar and an optical raingage onboard an anchored buoy 50 km offshore. Author

N91-30578# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
IMPACT OF ANTHROPOGENIC EFFECTS ON THE LAKE ACU BASIN BASED ON LANDSAT IMAGERY [IMPACTO DA ACAO ANTROPICA NA BACIA DO LAGO ACU (MA) ATRAVES DE IMAGENS LANDSAT]
Tania Maria Sausen and Kleber deFaria Apr. 1991 96 p In PORTUGUESE; ENGLISH summary Presented at the 6th Brazilian Symposium of Remot Sensing in Manaus, Brazil, 1990
(INPE-5020-RPE/614) Avail: NTIS HC/MF A05

In December 1987, there was a very high fish mortality in Lake Acu, motivating concern in the regional authorities about the environment. The objective is a multitemporal analysis to evaluate the antropic action effects and some natural factors in the environmental degradation in the Lake Acu watershed using LANDSAT/Multispectral Band Scanner (MSS)-Thematic Mapper (TM) images. Multispectral images corresponding to bands MSS 5 and 7 and to bands TM 3 and 4, of low water and high water periods, in the years of 1975, 1981, 1985, and 1989 were analyzed considering the drainage network and the land use evolution in the watershed. Author

N91-30579# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
CONTRIBUTIONS OF REMOTE SENSING TO FOREST RESOURCES MANAGEMENT: STATE OF THE ART AND PERSPECTIVES [SUBSIDIOS DO SENSORIAMENTO REMOTO PARA O MANEJO FLORESTAL: ESTADO ATUAL DA ARTE E PERSPECTIVAS]
Vitor CelsodeCarvalho, Yosio EdemirShimabukuro, Joao RobertodosSantos, and Pedro HernandezFilho Jan. 1991 26 p In PORTUGUESE; ENGLISH summary Presented at the 6th Brazilian Conference on Forest Resources, Sao Paulo, Brazil, 22-27 Sep. 1990
(INPE-5248-PRE/1679) Avail: NTIS HC/MF A03

A synthesis is presented of the principal contributions of remote sensing techniques to the process of forest resource management. These contributions are classified and organized into four basic areas: (1) identification and/or characterization; (2) classification and/or mapping; (3) evaluation and/or inventory; and (4) monitoring. A view of the state of the art is presented based on an analysis of the development of remote sensing technology in the last three years (1987 to 1989). Finally, new sensors development, in the short and medium time frame, are presented. Author

N91-30580# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
REMOTE SENSING AND DIGITAL PROCESSING OF GEOLOGICAL IMAGES [SENSORIAMENTO REMOTO E O PROCESSAMENTO DIGITAL DE IMAGENS EM GEOLOGIA]
Waldir RenatoParadella Apr. 1991 28 p In PORTUGUESE; ENGLISH summary Submitted for publication
(INPE-4828-PRE/1459) Avail: NTIS HC/MF A03

Orbital remote sensing data are available for geologic applications on a paper or a digital format through computer compatible tapes. The current trend based on the use of computers to analyze digital data has provided the impetus for the development of the Digital Image Processing of remotely sensed data, a generic term related to a set of techniques available for the extraction of information from digital data. The general aspects of this new approach to geological study are discussed. Author

N91-30581# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
SOIL EROSION RISK MAP: AN APPROACH USING THE GEOGRAPHIC INFORMATION SYSTEM AND ORBITAL IMAGERY M.S. Thesis [MAPA DE RISCO DE EROSAO DO SOLO: UMA ABORDAGEM USANDO SISTEMA DE INFORMACOES GEOGRAFICAS E IMAGENS ORBITAIS]
Eduardo Rodrigues VianadeLima Dec. 1990 164 p In PORTUGUESE; ENGLISH summary
(INPE-5229-TDL/434) Avail: NTIS HC/MF A08

A methodology is presented developed to generate soil erosion risk maps from Thematic Mapper (TM) using the INPE/GIS. Plans of information (P.I.'s) on erodibility of soils, erosivity by rainfall, lithology, slopes and vegetation cover were obtained and integrated within the INPE/GIS, in order to generate an erosion susceptibility map. The P.I. on vegetation cover was obtained from digital TM data and integrated at INPE/GIS with the erosion susceptibility map. The result was a soil erosion risk map. Author

N91-30582# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
TECHNIQUES OF MOVEMENT DETECTION IN THE MONITORING OF REFORESTED AREAS USING LANDSAT/TM DATA [TECNICAS DE DETECCAO DE MUDANCAS NO MONITORAMENTO DE AREAS REFLORESTADAS UTILIZANDO DADOS TM/LANDSAT]
David Chung Liang Lee, Pedro Hernandez Filho, and Yosio Edemir Shimabukuro Apr. 1991 35 p In PORTUGUESE; ENGLISH summary Original contains color illustrations
(INPE-5230-RPE/645) Avail: NTIS HC/MF A03

The change detection techniques are presented for monitoring the reforested areas using remote sensing multispectral data. The study area is located in the Mogi-Guacu municipality, State of Sao Paulo, which includes the Campininha Pine Experimental Station of the Forestry Institute of the State of Sao Paulo and the Santa Terezinha Eucalyptus Plantation of the Champion Cellulose and Paper Co. The LANDSAT-5/TM Computer Compatible Tape (CCT) data were analyzed by an image processing system using change detection techniques, such as Post-Classification Comparison, Multitemporal Classification, and Principal Components Analysis. The results permit the monitoring of change occurring in the reforested areas. Author

N91-30583# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
EVALUATION OF THE ACCURACY OF THEMATIC MAPPING AND MEASUREMENT OF AN AREA MAPPED FROM SATELLITE DATA [AVALIACAO DA EXATIDAO DE MAPA TEMATICO E MEDICAO DE AREA MAPEADA A PARTIR DE DADOS DE SATELITE]
Sherry Chou Chen Mar. 1991 34 p In PORTUGUESE; ENGLISH summary Submitted for publication
(INPE-5223-NTE/296) Avail: NTIS HC/MF A03

Viewing on the increasing public interests on problems of ecology and environmental preservation, remote sensing data have become an efficient tool for natural resource inventory monitoring studies. However, due to the difficulty in accessing relevant references, there is the lack of knowledge of the standard method to evaluate the results of remote sensing data in the user community. Thus, the main objective is to present statistical tests used to evaluate the mapping accuracy and methods to quantify mapped areas. Considerations for deforestation estimation in Legal Amazon using LANDSAT-TM images are also discussed. With the provided information remote sensing data users can evaluate confidences of their results for each specific application. Author

N91-30584# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
SPECTRAL REFLECTANCE OF LEAVES EX SITU: A METHODOLOGICAL APPROACH [REFLECTANCIA ESPECTRAL DE FOLHAS EX SITU: UMA ABORDAGEM METODOLOGICA]
Flavio Jorge Ponzoni and Mario Takao Inoue (Universidade Federal do Parana, Curitiba, Brazil) Apr. 1991 11 p In PORTUGUESE; ENGLISH summary Presented at the 4th Brazil Symposium on Remote Sensing, Manaus, 24-29 Jul. 1990
(INPE-5233-PRE/1673) Avail: NTIS HC/MF A03

Laboratory spectral measurements were carried out in order to determine the Eucalyptus sp. and Araucaria angustifolia detached leaves spectral reflectance, using a Spectron radiometer SE-590. The Eucalyptus sp. leaves were stored for several storage times in order to detect reflectance differences. The Araucaria leaves were collected from trees which presented different fungi attack levels. The results of these experiments were presented, including a methodological discussion and suggestions. Author

N91-30585# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
IMPLEMENTATION OF AN IMAGE PROCESSING SYSTEM USING AN EXTENDED DEFINITION OF THE IMAGE [IMPLEMENTACAO DE UM SISTEMA DE TRATAMENTO DE IMAGENS USANDO UMA DEFINICAO AMPLA DE IMAGENS]
Gerald Jean Francis Banon Apr. 1991 31 p In PORTUGUESE; ENGLISH summary Presented at the 3rd Brazilian Symposium on Remote Sensing, Rio de Janeiro, 28-30 Nov. 1984
(INPE-4742-PRE/1416) Avail: NTIS HC/MF A03

The objective was to develop an image processing system as a research tool, that with many levels of storage and computation, avoids the use of computer time in repetitious calculi, and simplifies new tasks. To do so, a larger sense of definition for the image concept was chosen. In this definition are included not only the numerical value of each element in the image, but also data giving the physical meaning of these elements, the way they have been obtained, and the place where they have been stored in the system. With respect to the processing step, it was seen as the successive application of elementary functions. To improve the efficiency of the processing system, and for easy use, in the image definition, the algorithm that produce it was included. From this new definition, an image processing system was implemented (using APL and FORTRAN languages) which allows the working of these images in a new way. Author

N91-30586# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
EFFECT OF COFFEE PLANTATION CULTURAL VARIABLES ON LANDSAT-5/TM M.S. Thesis [INFLUENCIA DE PARAMETROS CULTURAIS DE CAFEZAIS SOBRE OS DADOS TM/LANDSAT-5]
Luiz Leonardi Dec. 1990 171 p In PORTUGUESE; ENGLISH summary
(INPE-5209-TDL/430) Avail: NTIS HC/MF A08

Coffee fields are very complex at a remote sensing satellite view. The objective was to understand this complexity. To do that, TM LANDSAT-5 digital images and ground truth data were obtained nearly simultaneously. Digital data were transformed to reflectance values and the field data were analyzed in four stages: correlation between agronomic variables; correlation between spectral TM bands; correlation between agronomic variables and spectral response; and multiple regression analysis between cultural variables and coffee's spectral responses. The results indicated that variables related to the characteristics of the plant (height, pruning year, percentage of canopy cover, age, greenness and pruning type) were better correlated to the coffee reflectance than that variables related to the background characteristics (percentage of soil cover with organic material, weeds or bare soil), or that variable related to the geometry (row orientation, slope, slope aspect). Stepwise multiple regression analysis showed the predominant influence of coffee plants height and percentage of canopy cover variables on the spectral response of coffee canopies. Author

N91-30587# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
COMPARISON OF RADIOMETRIC TRANSFORMATION OF LANDSAT-5/TM DATA TO REFLECTANCE DATA M.S. Thesis [AVALIACAO DA TRANSFORMACAO RADIOMETRICA DOS DADOS TM/LANDSAT-5 EM REFLECTANCIAS]
Cristina Maria Bentz Dec. 1990 159 p In PORTUGUESE; ENGLISH summary
(INPE-5210-TDL/431) Avail: NTIS HC/MF A08

Remote sensing data are subject to a series of radiometric effects dependent on environmental and instrumental conditions specified to the image acquisition moment. In order to optimize the extraction of target intrinsic information, it is sought to normalize or correct theses unwanted effects by means of radiometric transformations which enhance the validity and comprehensibility of the obtained results. The present study tested digital value radiometric transformations from images to apparent reflectances and to atmospheric effect corrected reflectance by means of a method which uses image intrinsic information. The radiometric stability of the Thematic Mapper/LANDSAT-5 sensor was also observed from May, 1984 to May, 1987. The results showed that digital numbers and reflectances present different behaviors along the spectrum. The spectra of atmospheric corrected reflectances are those that most agree with the values of the reflectances

obtained from spectroradiometric field work. The effects due to different illumination and atmospheric conditions were reduced but not eliminated and the Thematic Mapper sensor kept stable responses. Author

N91-30588*# National Aeronautics and Space Administration, Washington, DC.
EARTH OBSERVATIONS AND GLOBAL CHANGE DECISION MAKING: A SPECIAL BIBLIOGRAPHY, 1991
Jun. 1991 99 p
(NASA-SP-7092; NAS 1.21:7092) Avail: NTIS HC/MF A05 CSCL 13B

The first section of the bibliography contains 294 bibliographic citations and abstracts of relevant reports, articles, and documents announced in 'Scientific and Technical Aerospace Reports (STAR)' and 'International Aerospace Abstracts (IAA)'. These abstracts are categorized by the following major subject divisions: aeronautics, astronautics, chemistry and materials, engineering, geosciences, life sciences, mathematical and computer sciences, physics, social sciences, space sciences and general. Following the abstract section, seven indexes are provided for further assistance. Author

N91-30589*# National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York, NY.
A GLOBAL DATA SET OF SOIL PARTICLE SIZE PROPERTIES
Robert S. Webb, Cynthia E. Rosenzweig, and Elissa R. Levine (National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.) Washington Sep. 1991 36 p
(NASA-TM-4286; Rept-91B00202; NAS 1.15:4286) Avail: NTIS HC/MF A03 CSCL 08M

A standardized global data set of soil horizon thicknesses and textures (particle size distributions) was compiled. This data set will be used by the improved ground hydrology parameterization designed for the Goddard Institute for Space Studies General Circulation Model (GISS GCM) Model 3. The data set specifies the top and bottom depths and the percent abundance of sand, silt, and clay of individual soil horizons in each of the 106 soil types cataloged for nine continental divisions. When combined with the World Soil Data File, the result is a global data set of variations in physical properties throughout the soil profile. These properties are important in the determination of water storage in individual soil horizons and exchange of water with the lower atmosphere. The incorporation of this data set into the GISS GCM should improve model performance by including more realistic variability in land-surface properties. Author

N91-30590# European Space Agency, Paris (France).
MULTISPECTRAL CLASSIFICATION OF OVERLAPPING CLASSES WITH APPLICATIONS TO FOREST DAMAGE AREAS
Peter Reinartz (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen, Germany, F.R.) May 1991 279 p Transl. into ENGLISH of Untersuchungen zur Multispektralen Klassifizierung von schwer trennbaren Klassen mit Beispielen aus Waldschadensgebieten (Oberpfaffenhofen, Fed. Republic of Germany, DLR), Jul. 1989 189 p Original language document was announced as N90-24666
(ESA-TT-1214; DLR-FB-89-55; ETN-91-99799) Avail: NTIS HC/MF A13

A critical investigation of the mutispectral classification of remotely sensed data is given and several proposals for the optimization of supervised classifications are made. Quantitative separability measures are derived for the analysis of class differentiability. Using these measures, criteria for the optimal selection of channels, training areas and classes can be determined, and artificial channels and radiometric correction algorithms can be quantitatively investigated. The methods developed are applied and tested for the classification of tree species and damage, using airborne Thematic Mapper data acquired by the linescanner DAEDALUS ATM 1286. ESA

N91-30591# European Space Agency, Paris (France).
THE SKIN TEMPERATURE OF MOUNTAIN SLOPES AND THE DETERMINATION OF THE SENSIBLE HEAT FLUX Ph.D. Thesis - Ludwig-Maximilians-Univ.
Hermann Mannstein (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen, Germany, F.R.) May 1991 178 p Transl. into ENGLISH of Die Radiometrisch Bestimmte Oberflaehentemperatur im Gebirge und die Ermittiung des Stroms Fuehlbarer Waerme (Oberpfaffenhofen, Fed. Republic of Germany, DLR), 1990 130 p Original language document was announced as N90-29754 Sponsored in part by Federal Ministry for Research and Technology
(ESA-TT-1220; DLR-FB-90-07; ETN-91-99801) Avail: NTIS HC/MF A09

Remotely sensed surface temperatures and profiles of air temperature in the Alps measured from aircraft are used to draw conclusions on the sensible heat flux from slope surfaces into the atmosphere. Since the data of the Advanced Very High Resolution Radiometer (AVHRR) of the NOAA series satellites have a very coarse resolution as compared with the scale of features in the Alpine region, techniques are used which enable data to be employed making sense even in the subpixel range. The sensible heat flux is derived from the theory of slope winds as a function of surface and atmospheric parameters, the difference between radiometrically determined surface temperature and air temperature at the same altitude having the greatest influence on the magnitude of the heat flux. ESA

N91-30592*# Commerce Energy NASA NLM Defense Information Cataloging Committee, Oak Ridge, TN.
DATA POLICY AND AVAILABILITY SUPPORTING GLOBAL CHANGE RESEARCH, DEVELOPMENT, AND DECISION-MAKING: AN INFORMATION PERSPECTIVE
Bonnie C. Carroll, Robert F. Jack, and Gladys A. Cotter (National Aeronautics and Space Administration, Washington, DC.) Oct. 1990 15 p
(NASA-TM-105137; NAS 1.15:105137) Avail: NTIS HC/MF A03 CSCL 13B

An explosion of information has created a crisis for today's information age. It has to be determined how to use the best available information sources, tools, and technology. To do this it is necessary to have leadership at the interagency level to promote a coherent information policy. It is also important to find ways to educate the users of information regarding the tools available to them. Advances in technology resulted in efforts to shift from Disciplinary and Mission-oriented Systems to Decision Support Systems and Personalized Information Systems. One such effort is being made by the Interagency Working Group on Data Management for Global Change (IAWGDMGC). Five federal agencies - the Department of Commerce (DOC), Department of Energy (DOE), National Aeronautics and Space Administration (NASA), National Library of Medicine (NLM), and Department of Defense (DOD) - have an on-going cooperative information management group, CENDI (Commerce, Energy, NASA, NLM, and Defense Information), that is meeting the challenge of coordinating and integrating their information management systems. Although it is beginning to be technically feasible to have a system with text, bibliographic, and numeric data online for the user to manipulate at the user's own workstation, it will require national recognition that the resource investment in such a system is worthwhile, in order to promote its full development. It also requires close cooperation between the producers and users of the information - that is, the research and policy community, and the information community. National resources need to be mobilized in a coordinated manner to move people into the next generation of information support systems. Author

N91-30173# Joint Publications Research Service, Arlington, VA.
SOVIET PARTICIPATION IN FIFE-1989 REMOTE SENSING STUDY
A. M. Grin and V. V. Kozoderov *In its* JPRS Report: Science and Technology. USSR: Space 26 Jun. 1991 p 24-27 Transl.

into ENGLISH from Priroda, Moscow (USSR), no. 12, Dec. 1990 p 60-65 (For primary document see N91-30170 22-12)
Avail: NTIS HC/MF A04

44 ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells; global sources of energy; geophysical conversion; and windpower.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *28 Propellants and Fuels.*

N91-30593# Office of Technology Assessment, Washington, DC.
ENERGY TECHNOLOGY CHOICES: SHAPING OUR FUTURE
Jul. 1991 157 p
(OTA-E-493) Avail: NTIS HC/MF A08; also available SOD HC $7.50 as 052-003-01251-1

This report provides a broad overview of energy choices facing the Nation. It is not an exhaustive analysis of any one technology; rather, it draws together the main themes of the Office of Technology Assessment (OTA) reports from the past 16 years, and other documents, into an outline of the main directions the country could follow. It reviews options for increasing the energy supply and using energy more efficiently in the face of resource constraints and the contrasting goals the Nation faces. It then analyzes packages of options that would be appropriate to meet national objectives. J.P.S.

N91-30594*# Georgia Tech Research Inst., Atlanta. Physical Sciences Lab.
INFRARED POWER CELLS FOR SATELLITE POWER CONVERSION Final Technical Report, 28 Jun. 1983 - 31 Jan. 1985
Christopher J. Summers Mar. 1991 72 p
(Grant NAG3-442; GTRI Proj. A-3575)
(NASA-CR-188723; NAS 1.26:188723) Avail: NTIS HC/MF A04 CSCL 10A

An analytical investigation is performed to assess the feasibility of long-wavelength power converters for the direct conversion of IR radiation onto electrical power. Because theses devices need to operate between 5 and 30 um the only material system possible for this application is the HgCdTe system which is currently being developed for IR detectors. Thus solar cell and IR detector theories and technologies are combined. The following subject areas are covered: electronic and optical properties of HgCdTe alloys; optimum device geometry; junction theory; model calculation for homojunction power cell efficiency; and calculation for HgCdTe power cell and power beaming. Author

N91-30595*# Rockwell International Corp., Canoga Park, CA. Rocketdyne Div.
INFRASTRUCTURE FOR DEPLOYMENT OF POWER SYSTEMS Final Report
Kenneth M. Sprouse Jun. 1991 86 p
(Contract NAS3-25808)
(NASA-CR-187167; NAS 1.26:187167) Avail: NTIS HC/MF A05 CSCL 10B

A preliminary effort in characterizing the types of stationary lunar power systems which may be considered for emplacement on the lunar surface from the proposed initial 100-kW unit in 2003 to later units ranging in power from 25 to 825 kW is presented. Associated with these power systems are their related infrastructure hardware including: (1) electrical cable, wiring, switchgear, and converters; (2) deployable radiator panels; (3) deployable photovoltaic (PV) panels; (4) heat transfer fluid piping and connection joints; (5) power system instrumentation and control equipment; and (6) interface hardware between lunar surface construction/maintenance equipment and power system. This report: (1) presents estimates of the mass and volumes associated with these power systems and their related infrastructure hardware; (2) provides task breakdown description for emplacing this equipment; (3) gives estimated heat, forces, torques, and alignment tolerances for equipment assembly; and (4) provides other important equipment/machinery requirements where applicable. Packaging options for this equipment will be discussed along with necessary site preparation requirements. Design and analysis issues associated with the final emplacement of this power system hardware are also described. Author

N91-30596# United Nations Industrial Development Organization, Vienna (Austria).
NEW MATERIALS FOR ELECTRONIC AND SOLAR DEVICES
21 Dec. 1990 67 p
(PB91-192039; UNIDO-IO.51(SPEC)) Avail: NTIS HC/MF A04 CSCL 10A

New materials for electronic and solar devices; applications of the photovoltaic (PV) systems; technological steps in the solar cell production; terms; technological steps in the solar cell production; examples of the cell processing technology; economic aspects of the PV panels production; application of PV systems; and leading PV research centers and companies are discussed. GRA

N91-30597*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
AMORPHOUS SILICON DEPOSITION RESEARCH WITH IN SITU DIAGNOSTICS
Yuh-Han Shing and F. Pool Apr. 1991 64 p
(Contracts NAS7-918; DE-AI01-85CE-89008)
(NASA-CR-188782; NAS 1.26:188782; DE91-013301; DOE/CE-89008/T2) Avail: NTIS HC/MF A04 CSCL 10A

This annual describes the research results of the Jet Propulsion Laboratory (JPL) Flat Plate Solar Photovoltaic Research Project, which is sponsored by the U.S. Department of Energy and is part of the National Photovoltaics Program to initiate a major effort toward the development of cost- competitive solar arrays. Electron cyclotron resonance (ECR) microwave plasma depositions of a-Si:H and a-SiC:H films have been investigated. The material properties of ECR-deposited a-Si:H films are comparable to conventional device-quality a Si:H films deposited by the radio frequency (RF) plasma enhanced chemical vapor deposition (PECVD). A new type of conductive a-Si:H films has also been deposited by ECR PECVD. The p-type doping of ECR-deposited, conductive a-Si:H films has shown a conductivity of 5 times 10(exp -2) Omega -cm(exp -1). Infrared spectroscopy reveals that the bonded hydrogen content in the conductive a-Si:H film is about a factor of ten less than that in the photosensitive a-Si:H film. Amorphous and microcrystalline SiC:H films have been deposited by ECR microwave plasmas using SiH4, CH4, and H2 gas mixtures. The deposition rate of a-Si:H films is found to be strongly dependent on the ECR magnetic field and the hydrogen dilution. The hydrogen dilution effect on the deposition rate indicates that the etching in ECR hydrogen plasmas plays and important role in the deposition of a-Si:H films. DOE

N91-30598# European Space Agency, Paris (France).
TYPE SPECIFIC DYNAMIC MEASUREMENTS ON WIND-POWER PLANT AT THE SCHNITTLINGEN TEST SITE (FED. REPUBLIC OF GERMANY)
Helmut Boehnisch, Alfred Kussmann, Klaus Reiniger, and Reimer Thiesen (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Stuttgart, Germany, F.R.) May 1991 129 p Transl. into ENGLISH of Anlagenspezifische Dynamische Messungen an Windkraftlagen auf dem Versuchfeld Schnittlingen (Stuttgart, Fed. Republic of Germany, DLR), 1990 110 p Original language document was announced as N90-12099
(ESA-TT-1174; DLR-Mitt-88-31; ETN-91-99795) Avail: NTIS HC/MF A07: Original German version available from DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 38.50 DM

The German Aerospace Research and Test Establishment has operated the Ulrich Hutter wind energy test site in the Schwebische

Alb for small and medium sized wind turbines since 1979. Dynamic stressing of components as well as the power and control characteristics on a number of wind turbines of different design and construction during varying weather and operational conditions are measured. High resolution data is transmitted from the rotating system to the ground station by means of telemetry. The data, from both the short timespan tests (with high data flow rate) and the long timespan measurements are first reduced by the data recording facility to allow an overview and initial judgement. Further evaluation is carried out off-line using the mainframe. The influence of the widely varying weather conditions on the control system and the performance of the wind turbines is of particular interest. The conclusions and recommendations achieved from this operational experience are presented. ESA

N91-30599# European Space Agency, Paris (France).
DESIGN OF HIGHLY CONCENTRATING SOLAR COLLECTORS AND SOLAR COLLECTOR SYSTEMS
Rainer Koehne (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Stuttgart, Germany, F.R.) May 1991 65 p Transl. into ENGLISH of Zur Auslegung Hochkonzentrierender Solarkollektoren und Solarkollektorsysteme (Stuttgart, Fed. Republic of Germany, DLR), Mar. 1990 61 p Original language document was announced as N91-10390
(ESA-TT-1224; DLR-FB-90-11; ETN-91-99804) Avail: NTIS HC/MF A04

The influence of the design of symmetric and asymmetric concentrating solar collector systems and of their optical quality on the maximum achievable thermal efficiency is investigated in a parameter study by means of the computer codes CIRCE and CAV2. Optimization considerations were carried out with respect to the aperture diameter and the shape of cavity receivers. Apart from the individual paraboloid dish, only systems consisting of many individual dishes or segments come into consideration for desired efficiencies of around 70 pct. at absorber temperatures of only between 800 and 1000C; for higher temperatures only the single dish is to be considered. Radiant flux densities that are too extreme can be avoided by an appropriate cavity shape with spherical or parabolic inner walls. Optimized receiver aperture diameters can increase the efficiency by 5 to 10 . ESA

N91-30600# Technische Univ., Berlin (Germany, F.R.). Inst. fuer Luft- und Raumfahrt.
TECHNOLOGY OF SOLAR POWER STATIONS: CONCEPT DEFINITION AND SIMULATION [TECHNOLOGIE SOLARER WELTRAUMKRAFTWERKE: KONZEPTDEFINITION UND SIMULATION]
Goetz R. Volkenandt 1 Feb. 1991 73 p In GERMAN; ENGLISH summary
(ILR-Mitt-253(1991); ETN-91-99461) Avail: NTIS HC/MF A04

The Solar Power Satellites (SPS) technology is described. The simulation model acts as a forecast model which describes possible future developments of the use of SPS technology. As the state of the art is increasing, a systematic integration of general concepts considering all actual aspects of SPS technology is the ideal base for a following technology assessment process. A summary of the most important results is given. ESA

N91-30601# Technische Univ., Eindhoven (Netherlands). Faculty of Electrical Engineering.
DERIVATION AND VERIFICATION OF A MODEL OF THE SYNCHRONOUS MACHINE WITH RECTIFIER WITH TWO DAMPER WINDINGS OF THE DIRECT AXIS
M. J. Hoeijmakers and J. M. Vleeshouwers Dec. 1990 144 p Sponsored by Netherlands Company for Energy and Environment, Ltd.
(EUT-90-E-248; ISBN-90-6144-248-6; ISSN-0167-9708; ETN-91-99628) Avail: NTIS HC/MF A07

Starting with the derivation of the separate models of the synchronous machine and the rectifier, a steady state model and a dynamic model are derived. The dynamic model is a global model, in which very fast phenomena, such as the ripple on the direct current, are neglected. Due to the abscence of very fast behavior the model is well suited for implementation in a control system for a wind turbine: with a minimum of computational effort the global behavior of the system can be predicted. Since the model contains a number of unknown synchronous machine parameters, a simple method was designed to estimate these parameters. It is based on the stand still step response test with the stator voltage as excitation and the stator (and rotor) currents as responses. A least squares estimator is used to estimate the parameters from the measurements. From the comparison of measured and simulated behavior of the synchronous machine with rectifier it follows that the model (in combination with the parameter estimation method) is a good description of the actual system. ESA

N91-30602# AiResearch Mfg. Co., Torrance, CA. Engineering Div.
YTTRIA-STABILIZED ZIRCONIA SOLID OXIDE ELECTROLYTE FUEL CELLS: MONOLITHIC SOLID OXIDE FUEL CELLS
Oct. 1990 99 p
(Contract DE-AC21-88MC-25166)
(DE91-002010; DOE/MC-25166/2961) Avail: NTIS HC/MF A05

The monolithic solid oxide fuel cell (MSOFC) is currently under development for a variety of applications including coal-based power generation. The MSOFC is a design concept that places the thin components of a solid oxide fuel cell in lightweight, compact, corrugated structure, and so achieves high efficiency and excellent performance simultaneously with high power density. The MSOFC can be integrated with coal gasification plants and is expected to have high overall efficiency in the conversion of the chemical energy of coal to electrical energy. This report describes work aimed at: (1) assessing manufacturing costs for the MSOFC and system costs for a coal-based plant; (2) modifying electrodes and electrode/electrolyte interfaces to improve the electrochemical performance of the MSOFC; and (3) testing the performance of the MSOFC on hydrogen and simulated coal gas. Manufacturing costs for both the coflow and crossflow MSOFC's were assessed based on the fabrication flow charts developed by direct scaleup of tape calendering and other laboratory processes. Integrated coal-based MSOFC systems were investigated to determine capital costs and costs of electricity. Design criteria were established for a coal-fueled 200-Mw power plant. Four plant arrangements were evaluated, and plant performance was analyzed. Interfacial modification involved modification of electrodes and electrode/electrolyte interfaces to improve the MSOFC electrochemical performance. Work in the cathode and cathode/electrolyte interface was concentrated on modification of electro deporosity, electrode morphology, electrode material, and interfacial bonding. Modifications of the anode and anode/electrolyte interface included the use of additives and improvement of nickel distribution. Single cells have been tested for their electrochemical performance. Performance data were typically obtained with humidified H2 or simulated coal gas and air or oxygen. DOE

N91-30603# Midwest Research Inst., Golden, CO. Solar Energy Research Inst.
RESEARCH ON STABLE, HIGH-EFFICIENCY, LARGE-AREA, AMORPHOUS-SILICON-BASED SUBMODULES
A. E. Delahoy, T. Tonon, and J. Macneil (Chronar Corp., Princeton, NJ.) Jun. 1991 62 p
(Contract DE-AC02-83CH-10093)
(DE91-002167; SERI/TP-214-4226) Avail: NTIS HC/MF A04

The primary objective of this subcontract is to develop the technology for same bandgap, amorphous silicon tandem junction photovoltaic modules having an area of at least 900 sq cm with the goal of achieving an aperture area efficiency of 9 percent. A further objective is to demonstrate modules that retain 95 percent of their under standard light soaking conditions. Our approach to the attainment of these objective is based on the following distinctive technologies: (1) in-house deposition of SiO2/SnO2:F onto soda lime glass by APCVD to provide a textured, transparent electrode; (2) single chamber r.f. glow discharge deposition of the a-Si:H layers onto vertical substrates contained with high package

density in a 'box carrier' to which the discharge is confined; (3) sputter deposition of highly reflecting, ZnO-based back contacts; and (4) laser scribing of the a-Si:H and electrodes with real-time scribe tracking to minimize area loss. Continued development of single junction amorphous silicon was aggressively pursued as proving ground for various optical enhancement schemes, new p-layers, and i-layers quality. We have rigorously demonstrated that the introduction of a transitional i-layer does not impair stability and that the initial gain in performance is retained. We have demonstrated a small improvement in cell stability through a post-fabrication treatment consisting of multiple, intense light flashes followed by sufficient annealing. Finally, several experiments have indicated that long term stability can be improved by overcoating the SnO2 with ZnO. DOE

N91-30604# Midwest Research Inst., Golden, CO. Solar Energy Research Inst.
PHOTOVOLTAIC ENERGY: PROGRAM OVERVIEW, FISCAL YEAR 1990
Jul. 1991 18 p
(Contract DE-AC02-83CH-10093)
(DE91-002170; DOE/CH-10093/93) Avail: NTIS HC/MF A03

This summary is prepared each year to provide an overview of the government-funded activities within the National Photovoltaics Program. The 1990 PV Program Achievements are listed. Launched the PV Manufacturing Technology initiative, designed to systematically lower PV module costs. Inaugurated the PV Concentrator Technologies Initiative by signing eight multiyear, cost-shared technology development subcontracts with concentrator companies. Established the PV Polycrystalline Thin-Film Initiative by signing six multiyear, cost-shared technology development subcontracts with six polycrystalline thin-film companies. Continued the Amorphous Silicon Project by awarding three new research and development contracts. Focused the resources of three program laboratories on finding solutions to industry's manufacturing problems: the Photovoltaic Device Fabrication Laboratory at Sandia National Laboratories and the Module Failure Analysis Laboratory and the Encapsulant Research Laboratory at SERI. Established an ongoing program to assist utilities in using PV for cost-effective, high-value applications. Completed nearly all of the construction planned for the first phase of PVUSA at Davis, California. Worked with the crystalline silicon PV industry on novel, low-cost cell fabrication processes and on resolving encapsulant problems. Took part in the development of qualification procedures tests for thin- and thick-film flat-plate modules and concentrator modules. DOE

N91-30605# Midwest Research Inst., Golden, CO. Solar Energy Research Inst.
SCIENCE PROJECTS IN RENEWABLE ENERGY AND ENERGY EFFICIENCY
Jul. 1991 130 p
(Contract DE-AC02-83CH-10093)
(DE91-002195; SERI-SP-220-4426) Avail: NTIS HC/MF A07

First, the book is written for teachers and other adults who educate children in grades K-12. This allows us to include projects with a variety of levels of difficulty, leaving it to the teacher to adapt them to the appropriate skill level. Second, the book generally focuses on experimental projects that demonstrate the scientific method. We believe that learning the experimental process is most beneficial for students and prepares them for further endeavors in science and for life itself by developing skills in making decisions and solving problems. Although this may appear to limit the book's application to more advanced students and more experienced science teachers, we hope that some of the ideas can be applied to beginning science classes. In addition, we recognize that there are numerous sources of nonexperimental science activities in the field and we hope this book will fill a gap in the available material. Third, we've tried to address the difficulties many teachers face in helping their students get started on science projects. By explaining the process and including extensive suggestions of resources - both nationally and locally - we hope to make the science projects more approachable and enjoyable. We hope the book will provide direction for teachers who are new to experimental projects. And finally, in each section of ideas, we've tried to include a broad sampling of projects that cover most of the important concepts related to each technology. Additional topics are listed as 'one-liners' following each group of projects. DOE

N91-30204*# Spire Corp., Bedford, MA.
TUNNEL JUNCTIONS FOR InP-ON-SI SOLAR CELLS
C. Keavney, S. Vernon, and V. Haven *In* NASA. Lewis Research Center, Space Photovoltaic Research and Technology Conference Aug. 1991 7 p (For primary document see N91-30203 22-20)
(Contract NAS3-25798)
Avail: NTIS HC/MF A20 CSCL 10B

N91-30205*# Midwest Research Inst., Golden, CO. Solar Energy Research Inst.
FABRICATION AND PERFORMANCE ANALYSIS OF 4-SQ CM INDIUM TIN OXIDE/InP PHOTOVOLTAIC SOLAR CELLS
T. A. Gessert, X. Li, P. W. Phelps, T. J. Coutts, and N. Tzafaras (Bell Telephone Labs., Inc., Reading, PA.) *In* NASA. Lewis Research Center, Space Photovoltaic Research and Technology Conference Aug. 1991 8 p (For primary document see N91-30203 22-20)
(Contract NASA Order C-3000-K; DE-AC02-83CH-10093)
Avail: NTIS HC/MF A20 CSCL 10B

N91-30206*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
A COMPARATIVE STUDY OF p(+)n AND n(+)p InP SOLAR CELLS MADE BY A CLOSED AMPOULE DIFFUSION
M. Faur, M. Faur, D. J. Flood, I. Weinberg, D. J. Brinker, C. Goradia, N. Fatemi (Sverdrup Technology, Inc., Cleveland, OH.), M. Goradia, and W. Thesling *In its* Space Photovoltaic Research and Technology Conference Aug. 1991 12 p (For primary document see N91-30203 22-20)
Avail: NTIS HC/MF A20 CSCL 10B

N91-30207*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
IMPROVEMENTS IN CONTACT RESISTIVITY AND THERMAL STABILITY OF Au-CONTACTED InP SOLAR CELLS
Navid S. Fatemi (Sverdrup Technology, Inc., Brook Park, OH.) and Victor G. Weizer *In its* Space Photovoltaic Research and Technology Conference Aug. 1991 7 p (For primary document see N91-30203 22-20)
Avail: NTIS HC/MF A20 CSCL 10B

N91-30208*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
GROOVED SURFACES ON InP
Sheila G. Bailey, Navid S. Fatemi, Geoffrey A. Landis, and Phillip P. Jenkins (Cleveland State Univ., OH.) *In its* Space Photovoltaic Research and Technology Conference Aug. 1991 6 p (For primary document see N91-30203 22-20)
Avail: NTIS HC/MF A20 CSCL 10B

N91-30209*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
EFFECT OF DISLOCATIONS ON PROPERTIES OF HETEROEPITAXIAL InP SOLAR CELLS
I. Weinberg, C. K. Swartz, H. B. Curtis, D. J. Brinker, P. Jenkins, and M. Faur (Cleveland State Univ., OH.) *In its* Space Photovoltaic Research and Technology Conference Aug. 1991 9 p (For primary document see N91-30203 22-20)
Avail: NTIS HC/MF A20 CSCL 10B

N91-30211*# Applied Solar Energy Corp., City of Industry, CA.
RECENT ADVANCES IN GaAs/Ge SOLAR CELLS
C. L. Chu, P. A. Iles, and W. Patterson (Air Force Avionics Lab., Wright-Patterson AFB, OH.) *In* NASA. Lewis Research Center, Space Photovoltaic Research and Technology Conference Aug. 1991 10 p (For primary document see N91-30203 22-20)
Avail: NTIS HC/MF A20 CSCL 10B

N91-30212*# Spectrolab, Inc., Sylmar, CA.
PRODUCTION STATUS OF GaAs/Ge SOLAR CELLS AND PANELS
B. Smith, M. Gillanders, P. Vijayakumar, D. Lillington, H. Yang, and R. Rolph (Hughes Aircraft Co., Torrance, CA.) *In* NASA. Lewis Research Center, Space Photovoltaic Research and Technology Conference Aug. 1991 7 p (For primary document see N91-30203 22-20)
Avail: NTIS HC/MF A20 CSCL 10B

N91-30213*# State Univ. of New York, Buffalo. Dept. of Electrical and Computer Engineering.
PHOTOREFLECTANCE AND DLTS EVALUATION OF PLASMA-INDUCED DAMAGE IN GaAs AND InP PRIOR TO SOLAR CELL FABRICATION
L. He and W. A. Anderson *In* NASA. Lewis Research Center, Space Photovoltaic Research and Technology Conference Aug. 1991 9 p (For primary document see N91-30203 22-20)
Avail: NTIS HC/MF A20 CSCL 10B

N91-30216*# Arizona State Univ., Tempe. Center for Solid State Electronics Research.
TWO-TERMINAL MONOLITHIC InP-BASED TANDEM SOLAR CELLS WITH TUNNELING INTERCELL OHMIC CONNECTIONS
C. C. Shen, P. T. Chang, and K. A. Emery (Midwest Research Inst., Golden, CO.) *In* NASA. Lewis Research Center, Space Photovoltaic Research and Technology Conference Aug. 1991 8 p (For primary document see N91-30203 22-20)
Avail: NTIS HC/MF A20 CSCL 10B

N91-30218*# Astropower, Inc., Newark, DE.
DEVELOPMENT OF N/P AlGaAs FREE-STANDING TOP SOLAR CELLS FOR TANDEM APPLICATIONS
Gerald H. Negley, Louis C. DiNetta, John R. Cummings, Margaret H. Hannon, Paul E. Sims, and Allen M. Barnett (Delaware Univ., Newark.) *In* NASA. Lewis Research Center, Space Photovoltaic Research and Technology Conference Aug. 1991 5 p (For primary document see N91-30203 22-20)
(Contract F33615-91-C-2144)
Avail: NTIS HC/MF A20 CSCL 10B

N91-30234*# Cleveland State Univ., OH. Dept. of Electrical Engineering.
FIESTA ROC: A NEW FINITE ELEMENT ANALYSIS PROGRAM FOR SOLAR CELL SIMULATION
Ralph O. Clark *In* NASA. Lewis Research Center, Space Photovoltaic Research and Technology Conference Aug. 1991 6 p (For primary document see N91-30203 22-20)
Avail: NTIS HC/MF A20 CSCL 10B

N91-30243*# Midwest Research Inst., Golden, CO. Solar Energy Research Inst.
RADIATION HARDNESS OF Ga0.5In0.5 P/GaAs TANDEM SOLAR CELLS
Sarah R. Kurtz, J. M. Olson, K. A. Bertness, D. J. Friedman, A. Kibbler, B. T. Cavicchi, and D. D. Krut (Spectrolab, Inc., Sylmar, CA.) *In* NASA. Lewis Research Center, Space Photovoltaic Research and Technology Conference Aug. 1991 7 p (For primary document see N91-30203 22-20)
Avail: NTIS HC/MF A20 CSCL 10B

N91-30244*# Boeing Co., Seattle, WA. High Technology Center.
THE EFFECTS OF ELECTRON AND PROTON RADIATION ON GaSb INFRARED SOLAR CELLS
P. E. Gruenbaum, J. E. Avery, and L. M. Fraas *In* NASA. Lewis Research Center, Space Photovoltaic Research and Technology Conference Aug. 1991 8 p (For primary document see N91-30203 22-20)
Avail: NTIS HC/MF A20 CSCL 10B

N91-30245*# SFA, Inc., Landover, MD.
TEMPERATURE COEFFICIENTS AND RADIATION INDUCED DLTS SPECTRA OF MOCVD GROWN n(+)p InP SOLAR CELLS
Robert J. Walters, Richard L. Statler, and Geoffrey P. Summers (Naval Research Lab., Washington, DC.) *In* NASA. Lewis Research Center, Space Photovoltaic Research and Technology Conference Aug. 1991 9 p Prepared in cooperation with Maryland Univ. Baltimore County, Catonsville (For primary document see N91-30203 22-20)
Avail: NTIS HC/MF A20 CSCL 10B

N91-30246*# Wayne State Univ., Detroit, MI. Dept. of Electrical and Computer Engineering.
ANNEALING CHARACTERISTICS OF AMORPHOUS SILICON ALLOY SOLAR CELLS IRRADIATED WITH 1.00 MeV PROTONS
Salman S. Abdulaziz and James R. Woodyard *In* NASA. Lewis Research Center, Space Photovoltaic Research and Technology Conference Aug. 1991 9 p (For primary document see N91-30203 22-20)
Avail: NTIS HC/MF A20 CSCL 10B

45 ENVIRONMENT POLLUTION

Includes atmospheric, noise, thermal, and water pollution.

N91-30606# Japan Automobile Research Inst., Tokyo.
AUTOMOBILES AND GLOBAL ENVIRONMENT PROBLEM WORKSHOP
16 Nov. 1990 107 p Workshop held in Japan, Nov. 1990
(DE91-778700; ETDE/JP-MF-1778700) Avail: NTIS HC/MF A06

Japan Automobile Research Institute makes a survey and research on how the transportation field where fossil fuel is used as energy source should cope with the global environment problem which is getting more critical. As one of the activities, they held in November 1990 the Automobiles and Global Environment Problem Workshop with assistance from MITI and Japan Motorcycle Racing Organization and had lectures and discussions by people of experience and learning. This report includes the following lectures: Measures to cope with the automobiles and global warming problem in the U.S. by GM's C. Amann, international trend of and measures against global warming, scientific information on global warming, global warming prevention technology in Japan, global warming measures in the Japanese automotive industry, the present situation and future of clean fuel (center dot) clean energy, a round-table discussion. Reports are made telling detailed circumstances and concrete measures as subjects in the transportation field mainly of the automotive industry. DOE

N91-30607*# Alaska Univ., Fairbanks. Geophysical Inst.
THE INFLUENCE OF THE HYDROLOGIC CYCLE ON THE EXTENT OF SEA ICE WITH CLIMATIC IMPLICATIONS
Semiannual Progress Report
Ken Dean and Joan Gosink 15 Aug. 1991 25 p LIMITED REPRODUCIBILITY: More than 20% of this document may be affected by color photographs Original contains color illustrations
(Grant NAGw-1835)
(NASA-CR-188716; NAS 1.26:188716) Avail: NTIS HC/MF A03; 7 functional color pages CSCL 13B

The role was analyzed of the hydrologic cycle on the distribution of sea ice, and its influence on forcings and fluxes between the marine environment and the atmosphere. River discharge plays a significant role in degrading the sea ice before any melting occurs elsewhere along the coast. The influence is considered of river discharge on the albedo, thermal balance, and distribution of sea ice. Quantitative atmospheric-hydrologic models are being developed to describe these processes in the coastal zone. Input for the models will come from satellite images, hydrologic data,

and field observations. The resulting analysis provides a basis for the study of the significance of the hydrologic cycle throughout the Arctic Basin and its influence on the regional climate as a result of possible climatic scenarios. The area offshore from the Mackenzie River delta was selected as the study area. Author

N91-30608# Environmental Protection Agency, Cincinnati, OH. Environmental Criteria and Assessment Office.
SENSITIVITY ANALYSIS OF A NESTED OZONE AIR QUALITY MODEL
G. Sistla, S. T. Rao, and J. Godowitch 1991 8 p Presented at the 7th AMS/AWMA Conference on Application of Air Pollution Meteorology, New Orleans, LA, 14-18 Jan. 1991 Prepared in cooperation with New York State Dept. of Environmental Conservation, Albany
(PB91-191221; EPA/600/D-91/085) Avail: NTIS HC/MF A02 CSCL 13B

A series of Urban Airshed Model (UAM) simulations were performed using inputs derived from Regional Oxidant Model (ROM) data files. The gridded ROM results employed in the UAM simulations included concentrations for specifying initial and boundary conditions, wind fields, other meteorological and surface geophysical parameters, and biogenic emissions. Two approaches were applied to nest the 3-D UAM grid (a four and a five level scheme) inside the regional model grid framework. The model sensitivity study was conducted with the variation in a single gridded input parameter or method in order to assess the impact on ozone concentrations for different high ozone days during 1980 over a domain covering the greater New York metropolitan area. Differences in the domain peak ozone and maximum ozone concentration at individual grid cells from the sensitivity runs are compared to base case simulations for each day. Maximum ozone levels were examined for different wind fields, with/without surface land use for the dry deposition method, with/without biogenic emissions, and the number of UAM vertical levels and nesting approach for initial and boundary concentrations. The magnitudes of peak ozone concentration changes from several sensitivity simulations were found to be comparable to those obtained from previous model runs with emissions control strategy reductions for the greater New York City urban domain. GRA

N91-30609# ManTech Environmental Technology, Inc., Corvallis, OR.
PREDICTING AND FORECASTING SURFACE WATER ACIDIFICATION: A PLAN FOR ASSESSING DATA AGGREGATION EFFECTS
M. G. Johnson, P. W. Shaffer, D. L. Stevens, K. W. Thornton, and R. S. Turner (Oak Ridge National Lab., TN.) Apr. 1991 66 p
(PB91-182451; EPA/600/3-91/024) Avail: NTIS HC/MF A04 CSCL 13B

A major goal of the Direct/Delayed Response Project (DDRP), a project within the U.S. Environmental Protection Agency's (EPA) Aquatic Effects Research Program (AERP) is to project potential changes in surface water chemistry in lakes in the northeastern U.S. and streams in the mid-Appalachians and Southeastern U.S. over the next 50 years as a function of current and alternative levels of acidic deposition. The DDRP projections are based on various types of simulation models that predict surface water and soil chemistry. All models, statistical, empirical, mechanistic, logical, and others, represent a simplification or abstraction of the real world. A major question associated with the application of a model is how to prepare subset, and aggregate, or limp data so that they represent the processes and systems being simulated. The models used in the DDRP require physical and chemical data on watershed solid as part of the model inputs. In conjunction with the DDRP, soil surveys were conducted in selected watersheds in each of the three regions. The document describes and discusses the approaches used in the DDRP for aggregating soil chemical and physical data for use in the various DDRP analyses. GRA

N91-30610*# Nebraska Univ., Lincoln. Dept. of Agricultural Meteorology.
[ANALYSIS OF FIELD MEASUREMENTS OF CARBON DIOXIDE AND WATER VAPOR FLUXES] Progress Report, 1 Dec. 1990 - 31 Aug. 1991
Shashi B. Verma 1991 38 p
(Grant NAG5-890)
(NASA-CR-188781; NAS 1.26:188781) Avail: NTIS HC/MF A03 CSCL 13B

Analysis of the field measurements of carbon dioxide and water vapor fluxes is discussed. These data were examined in conjunction with reflectance obtained from helicopter mounted Modular Multiband Radiometer. These measurements are representative of the canopy scale (10 to 100 m)(exp 2) and provide a good basis for investigating the hypotheses/relationship potentially useful in remote sensing applications. All the micrometeorological data collected during FIFE-89 were processed and fluxes of CO2, water vapor, and sensible heat were calculated. Soil CO2 fluxes were also estimated. Employing these soil CO2 flux values, in conjunction with micrometeorological measurements, canopy photosynthesis is being estimated. A biochemical model of leaf photosynthesis was adapted to the prairie vegetation. The modeled leaf photosynthesis rates were scaled up to the canopy level. This model and a multiplicative stomatal conductance model are also used to calculate canopy conductance. Author

N91-30611# Stockholm Univ. (Sweden). Dept. of Meteorology.
THE MISU BASELINE STATION
Jost Heintzenberg, John Ogren, Sven-Aake Odh, Leif Baecklin, and Tron Danielsen (Norwegian Inst. for Air Research, Lillestrom.) Apr. 1991 43 p Prepared in cooperation with International Meteorological Inst., Stockholm, Sweden
(AA-2; ISSN-1101-4814; ETN-91-99786) Avail: NTIS HC/MF A03

The MISU (acronym for University of Stockolm Department of Meteorology) baseline monitoring stations for CO2 and aerosol particles is described. The station is the result of ten years of instrumental development and field experiments on Spitsbergen (Sweden). It consists of a collection of state of the art sensors connected to redundant data collection system. In the gas phase the key greenhouse gas CO2 is recorded with one minute resolution. Essential parameters of the atmospheric aerosol such as a number concentration in two size ranges and their light scattering coefficient at 0.55 micron wavelength are logged with the same time resolution. Together with the information from the meteorological and cloud sensors, this information can be used two ways. First and foremost long term changes in the state of the Arctic atmosphere can be monitored. Beyond this traditional use of the baseline stations the high time resolution and sensitivity of the aerosol instruments lends itself to front line research on aerosol transformation in clouds and on the formation of particles in the Arctic atmosphere. ESA

N91-30612 Physics and Electronics Lab. TNO, The Hague (Netherlands).
OBSCURANT MEASUREMENTS DURING BEST-TWO BY MEANS OF MPTR Final Report
A. N. deJong Nov. 1990 41 p
(Contract A90/KL/621)
(FEL-90-A290; TD-90-3535; ETN-91-99812) Copyright Avail: Physics and Electronics Lab. TNO, P.O. Box 96864, 2509 JG The Hague, Netherlands

The Multi Path Transmission Radiometer (MPTR) is used during the BEST-TWO trials to carry out measurements on obscurants. These obscurants are dusty from simulated artillery barrage, smoke from oil fires, and dust from single and multiple vehicles. Results are presented which characterize these obscurants. The transmission measurements are combined with a number of other experiments at the same location. These experiments are reported separately. ESA

N91-30613*# Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
TRACE GAS AND AEROSOL TRANSPORTS INTO AND OUT OF THE AMAZON BASIN Progress Report, 1 Jan. 1990 - 31 Aug. 1991
Michael Garstang and Steven Greco Sep. 1991 184 p Original contains color illustrations
(Contract NCC1-106)
(NASA-CR-188786; NAS 1.26:188786) Avail: NTIS HC/MF A09; 1 functional color page CSCL 13B

Overviews of the wet season Amazon Boundary Layer Experiment (ABLE IIB) are presented which give the context of the wet season experiment and some of the results. Copies of all reprints and manuscripts published or accepted for publication are attached. A complete list of all papers published in the reviewed literature, papers presented as well as published as part of conference preceedings, and articles published in the news media are listed in the appendices. Two scales of interaction of the rain forest were pursued in this work: (1) global interactions; and (2) local and regional interactions. Under the first scale, the role of the rain forest in the global system was the central thrust of the work. Under the second scale, the role of the rain forest on the basin and smaller scales was emphasized. The appendices also provide a summary of future work and a listing of degrees awarded during this report period. Author

N91-30614# Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H., Vienna. Hauptabt. Umweltplannung.
RESEARCH AND DEVELOPMENT TRENDS OF ENVIRONMENTAL CONTROL TECHNIQUES
Edgar Cabela Feb. 1991 17 p In GERMAN; ENGLISH summary Presented at the 21st Technologie- und Innovationsgespraech der Tiroler Handelskammer/Sektion Industrie, Innsbruck, Austria, 9 Nov. 1990
(OEFZS-4569; ETN-91-99498) Copyright Avail: NTIS HC/MF A03

A review of different strategic solutions in the field of environmental protection is given. Its influence on the development of environmental control techniques is emphasized. Research and development trends in important fields of environmental control techniques are described. ESA

N91-30615 Institut d'Aeronomie Spatiale de Belgique, Brussels.
SPRING POLAR OZONE BEHAVIOR
A. C. Aikin 1991 63 p Original contains color illustrations
(Aeronomica-Acta-A-359-1991; ISSN-0065-3713; ETN-91-99536)
Avail: Institut d'Aeronomie Spatiale de Belgique, 3 Avenue Circulaire, B-1180 Brussels, Belgium

Understanding of the springtime behavior of polar stratospheric ozone as of mid 1990 is summarized. Heterogeneous reactions on polar stratospheric clouds as hypothesis for ozone loss are considered and a simplified description of the behavior of Antarctic ozone in winter and spring is given. Evidence that the situation is more complicated than described by the theory is produced. Many unresolved scientific issues remain and some of the most important problems are identified. Ozone changes each spring since 1979 have clearly established for the first time that man made chlorine compounds influence stratospheric ozone. Long before important advances in satellite and in situ investigations, it was Dobson's decision to place a total ozone measuring spectrometer at Halley Bay in Antartica during the International Geophysical Year and subsequent continuous monitoring which led to the discovery that ozone was being destroyed each spring by chlorine processed by polar stratospheric clouds. ESA

46 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation.*

N91-30616*# Aeritalia S.p.A., Turin (Italy). Space Systems Group.
TETHERED GRAVITY LABORATORIES STUDY Final Report
F. Lucchetti May 1990 379 p
(Contract NAS9-17877)
(NASA-CR-185628; NAS 1.26:185628) Avail: NTIS HC/MF A17 CSCL 08G

The scope of the study is to investigate ways of controlling the microgravity environment of the International Space Station by means of a tethered system. Four main study tasks were performed. First, researchers analyzed the utilization of the tether systems to improve the lowest possible steady gravity level on the Space Station and the tether capability to actively control the center of gravity position in order to compensate for activities that would upset the mass distribution of the Station. The purpose of the second task was to evaluate the whole of the experiments performable in a variable gravity environment and the related beneficial residual accelerations, both for pure and applied research in the fields of fluid, materials, and life science, so as to assess the relevance of a variable g-level laboratory. The third task involves the Tethered Variable Gravity Laboratory. The use of the facility that would crawl along a deployed tether and expose experiments to varying intensities of reduced gravity is discussed. Last, a study performed on the Attitude Tether Stabilizer concept is discussed. The stabilization effect of ballast masses tethered to the Space Station was investigated as a means of assisting the attitude control system of the Station. Author

N91-30617# Utah State Univ., Logan. Space Dynamics Labs.
WAVE DYNAMICS IN THE MESOSPHERIC HYDROXYL LAYER
Hitoshi Yoshimoto 1 Aug. 1990 213 p
(Contract F19628-87-C-0100)
(AD-A229306; SDL/90-049; SCIENTIFIC-1; GL-TR-90-0211)
Avail: NTIS HC/MF A10 CSCL 04/1

Due to the improvement of infrared measuring instruments, it is possible to observe the middle atmospheric airglow directly from ground-based sites with fine temporal and spatial resolution. In such studies, temporal and spatial fluctuations are found in two major observables: emission intensity and rotational temperature. One possible cause of such fluctuations is passing atmospheric disturbances, known as internal gravity waves. There have been considerable theoretical modeling efforts and experimental investigations to test this hypothesis. An attempt is made to develop a theoretical model of the mesospheric airglow observables. The model uses underlying physical and chemical processes to derive the following physical entities as functions of altitude: the concentrations of major species and minor but influential species and the kinetic temperature of the neutral atmosphere. The model also incorporates geometrical configurations in order to estimate the following observables: the infrared emission intensity for a particular vibrational band and the rotational emission-line intensities for a particular vibrational band. Many theoretical models assume that gravity waves are monochromatically sinusoidal. Such an assumption seems not to be valid, based upon the propagation characteristics of the waves. GRA

N91-30618# National Oceanic and Atmospheric Administration, Boulder, CO.
PROCEEDINGS OF THE WORKSHOP ON GEOPHYSICAL INFORMATICS
J. H. Allen and V. A. Nechitailenko Jan. 1991 31 p Workshop held in Moscow (USSR), 14-18 Aug. 1988 Prepared in cooperation with National Geophysical and Solar-Terrestrial Data Center, Boulder, CO, and Academy of Sciences (USSR), Moscow
(PB91-164376; UAG-99) Avail: NTIS HC/MF A03 CSCL 08G

Various topics related to geophysical information were discussed at the conference. Topics covered include the World Data Center

System, the National Climate Data Center informational systems and plans, a distributed information system for planetary geophysics, some considerations concerning data sets for global change, computer networking, a prototype data base management system, and data finding in a distributed international environment. Author

N91-30619*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
CONSIDERATION OF PERMANENT TIDAL DEFORMATION IN THE ORBIT DETERMINATION AND DATA ANALYSIS FOR THE TOPEX/POSEIDON MISSION
Richard H. Rapp, R. Steven Nerem, C. K. Snum, Steven M. Klosko, and Ronald G. Williamson (ST Systems Corp., Lanham, MD.) Jan. 1991 15 p
(Contracts JPL-958121; JPL-958122)
(NASA-TM-100775; NAS 1.15:100775; Rept-91B00049) Avail: NTIS HC/MF A03 CSCL 04A

The effects of the permanent tidal effects of the Sun and Moon with specific applications to satellite altimeter data reduction are reviewed in the context of a consistent definition of geoid undulations. Three situations are applicable not only for altimeter reduction and geoid definition, but also for the second degree zonal harmonic of the geopotential and the equatorial radius. A recommendation is made that sea surface heights and geoid undulations placed on the Topex/Poseidon geophysical data record should be referred to the mean Earth case (i.e., with the permanent effects of the Sun and Moon included). Numerical constants for a number of parameters, including a flattening and geoid geopotential, are included. Author

N91-30620*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
SOLAR-TERRESTRIAL MODELS AND APPLICATION SOFTWARE
Dieter Bilitza Jul. 1990 96 p
(NASA-TM-105052; NAS 1.15:105052;
NSSDC/WDC-A-R/S-90-19) Avail: NTIS HC/MF A05 CSCL 04A

The empirical models related to solar-terrestrial sciences are listed and described which are available in the form of computer programs. Also included are programs that use one or more of these models for application specific purposes. The entries are grouped according to the region of the solar-terrestrial environment to which they belong and according to the parameter which they describe. Regions considered include the ionosphere, atmosphere, magnetosphere, planets, interplanetary space, and heliosphere. Also provided is the information on the accessibility for solar-terrestrial models to specify the magnetic and solar activity conditions. Author

N91-30621*# Science Applications Research, Lanham, MD.
INTERNATIONAL REFERENCE IONOSPHERE 1990
Dieter Bilitza, K. Rawer, L. Bossy, I. Kutiev, K.-I. Oyama, R. Leitinger, and E. Kazimirovsky Nov. 1990 150 p
(NASA-TM-105055; NAS 1.15:105055;
NSSDC/WDC-A-R/S-90-22) Avail: NTIS HC/MF A07 CSCL 04A

The International Reference Ionosphere 1990 (IRI-90) is described. IRI described monthly averages of the electron density, electron temperature, ion temperature, and ion composition in the altitude range from 50 to 1000 km for magnetically quiet conditions in the non-auroral ionosphere. The most important improvements and new developments are summarized. Author

N91-30622 Colorado State Univ., Fort Collins.
EARTH RADIATION BUDGET VARIABILITY AND THE RELATIONSHIP TO CHANGES IN THE GENERAL CIRCULATION Ph.D. Thesis
David L. Randel 1990 124 p
Avail: Univ. Microfilms Order No. DA9117201

The geographical variability of the radiation balance forces the different atmospheric circulations. To fully comprehend the variability in these atmospheric flow patterns we must address the fundamental problems of how changes in the earth radiation budget (ERB) affects these circulations, and also the role of clouds in modification of the ERB. The Nimbus-7 satellite ERB climatology from 1978-1987 is presented as well as the interannual variability. The areas with highest variations are reported for each of the ERB parameters and show the pronounced effect of the 1982-1983 El Nino. Concurrent with the ERB observations is a independent five year cloud climatology allowing for comparisons of ERB with estimates of total and multi-level cloud amounts. The area of greatest variability in the net balance occurs off the west African coast where there are mainly in convective cloudiness. The circulation data includes eight years of ECMWF (European Center for Medium Range Weather Forcasts) global winds and temperatures from which the eddy and zonal components of the available potential and kinetic energies are computed. The circulation differences between the continental Northern Hemisphere and oceanic Southern Hemisphere are interpreted in terms of the magnitudes of these energetic terms. For the direct study of ERB and energetic comparisons, a simultaneous time series of mid-latitude ERB gradients and hemispheric averaged energetics are examined. By doing a time correlation study we found the annual cycles of the radiation gradients to lead the energetics by 2-3 weeks. The spatial relationship of the variability in the ERB related to tropical circulations is investigated through spatial correlations. Dissert. Abstr.

N91-30623 Georgia Inst. of Tech., Atlanta.
A SEARCH FOR STRANGE ATTRACTORS IN THE SATURATION OF MIDDLE ATMOSPHERE GRAVITY WAVES Ph.D. Thesis
Jason Pierce Tuell 1990 262 p
Avail: Univ. Microfilms Order No. DA9115399

Evidence was sought of a strange attractor associated with the saturation of middle atmosphere gravity waves in the echo data from a partial reflection radar located in Saskatoon, Canada. Theiler's extension of the Grassberger-Procaccia (GP) correlation integral algorithm was used to estimate the fractal dimension of the attractor. Chaotic regimes were observed in experimental fluid studies of the transition from ordered to turbulent behavior. Breaking gravity waves are thought to decay to turbulence, transporting momentum from the lower to upper atmosphere. Extending the results from lab studies to middle atmosphere gravity waves, it seems reasonable to expect to find a strange attractor in gravity wave saturation. Echo data was analyzed because it offered a high sampling rate. The GP algorithm places stringent requirements upon the amount of data necessary to obtain an accurate estimate of the system dimension; a large number of points is required. A strange attractor was not detected with dimension less than 3 in the data from the Saskatoon partial reflection radar for the time scales (6 min 39 s) which were studied. It can not be asserted that a strange attractor is absent in gravity wave absorption. The data requirements to implement the GP algorithm make it unlikely that such an attractor, if it exists, will be detected. Dissert. Abstr.

N91-30624 Michigan Univ., Ann Arbor.
AN INVESTIGATION ON THE MULTIORDER FABRY-PEROT INTERFEROMETER AS A SATELLITE-BORNE HIGH-RESOLUTION ATMOSPHERIC TEMPERATURE SOUNDER Ph.D. Thesis
Jinxue Wang 1990 246 p
Avail: Univ. Microfilms Order No. DA9116319

With the development of high resolution atmospheric modeling and mesoscale numerical prediction models for weather forecasting, there is an increasing demand to improve the vertical resolution and retrieval accuracy of the present atmospheric temperature sounder. The most effective way to improve the vertical resolution and retrieval accuracy of atmospheric temperature sounding is to use high spectral resolution instruments. It is well known that carbon dioxide (CO_2) has a periodic spectrum in its P and R branches of the 15-micron and 4.3-micron bands. The Fabry-Perot interferometer (FPI) is a periodic, high resolution, and

high throughput instrument. The use of FPI, denoted as the Multiorder Etalon Sounder (MOES), to observe the periodic CO2 spectrum presents a novel approach to atmospheric temperature sounding. In this thesis project, the concept of vertical temperature profiling with the multiorder Fabry-Perot interferometer has been established. Suitable spectral regions and optimum FPI free spectral ranges have been calculated. A conceptual instrument design for a Low-Earth-Orbit (LEO) satellite has been carried out, critical instrumentation issues have been identified and discussed. Instrument performance has been simulated and compared with the current operational High Resolution Infrared Radiation Sounder (HIRS/2). The characteristics of 44 temperature sounding channels and 12 water vapor sounding channels have been studied, results indicate that MOES is capable of achieving some narrow and sharp weighting functions. Instrument sensitivity analysis indicates that to achieve a NE delta T of 0.2 K at T equals 260 K, a 10 km nadir footprint, and synchronization with AMSU, at least a 12 inch (diameter) telescope is needed. The retrieval simulation studies show that MOES can provide much better temperature and water vapor profiles than HIRS/2. Because of the uniform vibrational-rotational band structures of carbon monoxide (CO) and nitrous oxide (N20), MOES is also a potentially feasible technique to measure the global tropospheric CO and N2O concentrations. The characteristics of possible CO and N2O sounding channels and instrument sensitivities have also been briefly discussed.
Dissert. Abstr.

N91-30625 Michigan Univ., Ann Arbor.
THERMAL ION UPWELLING IN THE HIGH-LATITUDE IONOSPHERE Ph.D. Thesis
Richard Walter Cannata 1990 240 p
Avail: Univ. Microfilms Order No. DA9116138

High latitude observations of thermal ion outflows, traditionally known as the 'polar wind', and heavy ion upwellings, consisting chiefly of heated O(+), suggest that the terrestrial ionosphere acts as an important, and at times, dominant source of ions for the magnetosphere. The topside ionospheric processes responsible for modulating both types of polar ion flows were examined to quantify the magnitudes and compositional variability of steady state polar wind flows and to identify the role of low altitude frictional heating in transient heavy ion upwellings. Theoretical and experimental approaches were used to elucidate the high latitude processes that influence ionospheric source strength and transient behavior. A time dependent hydrodynamic model was used to examine solar cycle and seasonal dependencies under steady state assumptions. The role of low altitude ion frictional heating was examined by coupling the National Center for Atmospheric Research Thermosphere/Ionosphere General Circulation Model (NCAR-TIGCM) to the polar wind model to specify time dependent frictional heating during a period of observed high altitude O(+) outflow. Preferential O(+) heating resulted in a factor of four increase in modeled O(+) fluxes, which coincides in both space and time with the observed heavy ion outflows. Finally, the role of frictional heating and global heating morphology was related to observations of high altitude ion outflows using Dynamics Explorer 2 satellite data and incoherent scatter radar observations. The locations and dynamic behavior of global frictional heating patterns were found to match well with statistical locations of heavy ion outflows, further suggesting that energization by frictional heating is an important contributing process in initiating transient heavy ion outflows.
Dissert. Abstr.

N91-30626 California Univ., Riverside.
LABORATORY SIMULATION OF THE MAGNETOSPHERE, MAGNETOTAIL RECONNECTION AND THE STUDY OF FIELD-ALIGNED CURRENTS Ph.D. Thesis
Gung Yur 1990 132 p
Avail: Univ. Microfilms Order No. DA9116712

A laboratory simulation of the Earth's magnetosphere was performed. A wide plasma beam simulates the solar wind plasma. An externally applied magnetic field throughout the interaction chamber is varied between -300 and +300 G to simulate the interplanetary magnetic field (IMF). This magnetized plasma beam interacts with a spherical dipole magnetic field that simulates the planetary field to form a planetary type plasma sphere. Cusp structures and particle precipitations are studied with optical time exposure photographs of the simulated magnetosphere. The structure is strongly controlled by the polarity of the IMF. The global structure of the magnetosphere is measured in detail for different values of the IMF at various locations in the magnetosphere. Particularly, the magnetic field measurements in the tail reveal interesting reconnection processes. The main experimental parameters are selected in such a way that, at least, MHD scaling is satisfied.
Dissert. Abstr.

N91-30627 Texas Univ., Austin.
LABORATORY STUDIES OF COHERENT STRUCTURES IN QUASI-GEOSTROPHIC FLOWS Ph.D. Thesis
Steven David Meyers 1990 151 p
Avail: Univ. Microfilms Order No. DA9116929

Laboratory experiments were conducted in a large, rapidly rotating annulus of fluid. Low Rossby and Ekman numbers, 0.1 and 10(exp -5) respectively, were achieved while maintaining large Reynolds number (greater than 10(exp 4)). The apparatus had a flat lid and conical bottom (slope s = -0.1) to mimic the planetary beta-effect. Motion was forced with six source-sink pairs, distributed symmetrically n a ring in the bottom of the tank. Two primary flow states were studied; marginally stable westward and eastward jets. Westward jets tended to be wide, and developed a central region of strong shear with quasi-uniform potential vorticity. Elliptical vortices of the same sign as the shear always formed. Due to design limitations, only cyclonic vortices were produced. Multiple vortex states were found for relatively narrow jets when the inertial time scale was comparable to the Ekman time scale. Eastward jets tended to be narrow and exhibited Rossby wave instability. The number of waves was fairly well predicted by linear theory, except for the low forcing situation, when the pumping geometry strongly influenced the instability. Potential vorticity was quasi-uniform on either side of the jet, with a strong gradient in the jet center.
Dissert. Abstr.

N91-30628 Pennsylvania State Univ., University Park.
BACKSCATTERING BY NONSPHERICAL PARTICLES, USING THE COUPLED-DIPOLE METHOD: AN APPLICATION IN RADAR METEOROLOGY Ph.D. Thesis
Clifton Elwood Dungey 1990 152 p
Avail: Univ. Microfilms Order No. DA9117673

In the coupled-dipole method, an arbitrary particle is modeled as an array of N polarizable subunits each of which gives rise to only electric dipole radiation. The total scattering is calculated by summing the waves scattered by each dipolar subunit excited by the incident wave and the waves of all the other dipolar subunits. By accounting for the dipolar interactions, the accuracy of the scattering calculations improves, but the mathematics become more complicated. The matrix inversion and scattering-order techniques are used to solve for the dipolar interactions. The Clausius-Mosotti relation has been the most widely used effective medium theory to relate the polarizability of the dipolar subunits to the refractive index of the bulk particle that the array represents. The polarizability of the dipolar subunits has been calculated using the electric dipole coefficient from Mie theory. This alternative expression for polarizability leads to scattering calculations that better agree with Mie theory. Of all scattering angles, backscattering is the most sensitive to small changes in particle size and shape. Backscattering of 94 GHz Doppler radar by raindrops can be used to infer clear air velocity; backscattering by ice crystals may provide similar information. Backscattering at 94 GHz by randomly oriented ice plates or columns does not agree with backscattering by equal-volume ice spheres for size parameters greater than 0.8.
Dissert. Abstr.

N91-30629# Geological Survey, Denver, CO.
MAGNETOSTRATIGRAPHY OF THE SAN FRANCISCO VOLCANIC FIELD, ARIZONA
K. L. Tanaka, T. C. Onstott, and E. M. Shoemaker 1990 43 p

(PB91-190306; USGS-BULL-1929; LC-90-2914) Avail: NTIS HC/MF A03 CSCL 08G

Remanent magnetizations were determined for 657 sites of volcanic rocks in the San Francisco volcanic field, an area of about 4800 sq km in the southern part of the Colorado Plateau. The field includes scattered basaltic cinder cones and flows as well as silicic and intermediate rocks, mostly in voluminous eruptive centers. About 90 percent of the sites yielded clear polarity determinations; the remainder have scattered data or peculiar directions. Comprehensive stratigraphic controls - paleomagnetic polarity data, K-Ar and other and other absolute age determinations, superposition relations, and lithologic associations - and the state of preservation of the cinder cones provide a basis for age assignments of 503 separate eruptions related to basaltic vents and flows and 80 silicic to intermediate domes, flows, and flow sequences. The eruptions are assigned to three magnetopolarity sequences (polarity chronozones). Author

N91-30630# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

STUDY OF THE BEHAVIOR OF ELECTRON DENSITY OF THE LOWER IONOSPHERE DURING ABSORPTION OF THE POLAR CAP AT LATITUDES IN THE SOUTHERN HEMISPHERE AND THE REGION OF THE SOUTH ATLANTIC GEOMAGNETIC ANOMALY Ph.D. Thesis, 18 Sep. 1989 [ESTUDO DO COMPORTAMENTO DA DENSIDADE ELETRONICA DA BAIXA IONOSFERA DURANTE ABSORCAO DA CALOTA POLAR EM ALTAS LATITUDES NO HEMISFERIO SUL E NA REGIAO DA ANOMALIA GEOMAGNETICA DO ATLANTICO SUL]

Aracy MendesdaCosta Apr. 1991 337 p In PORTUGUESE; ENGLISH summary

(INPE-5232-TDL/439) Avail: NTIS HC/MF A15

A study is presented of the effect of Solar Proton events (PCA's) that occurred from September 1967 to November 1974, on the phase and amplitude records of very low frequency (VLF) signals on NWC (Australia) - Sao Paulo (Brazil) propagation path, crossing the Southern Hemisphere auroral zone. Twenty five of more than a hundred events of different intensities that occurred in this period were studied and the most relevant ones were described in detail. Simultaneous analysis of transequatorial VLF propagation paths received in Sao Paulo and Curitiba (Brazil) showed also the significant contribution of the South Atlantic Geomagnetic Anomaly to the ionization of the lower part of the ionospheric D-region during the PCA events. The outstanding results was the determination of day and nighttime electron density fitting exponential models to the data analyzed for two regions up to now poorly known: The Antarctic region and the South Atlantic Geomagnetic Anomaly. Author

N91-30631 Defence Research Establishment Valcartier (Quebec).

A TEMPERATURE DEPENDENT REGULAR INFRARED BAND MODEL

P. L. Roney Nov. 1989 42 p Previously announced in IAA as A89-49567

(DREV-4559-89; CTN-91-60196) Avail: NTIS HC A03

The computer code LOWTRAN is very widely used for the calculation of atmospheric transmittance and radiation in the 0.25-28 micron spectral region. LOWTRAN utilizes temperature independent molecular absorption coefficients and approximates molecular line absorption by a one-parameter band model for a spectral resolution of 20/cm. A temperature dependent infrared band model for the absorption or emission of spectral lines simultaneously broadened by Doppler and collisional effects is developed. The model is an extension of Elsasser's model for lines of equal spacing and intensity. It is given in the form of an infinite series which converges rapidly and is appropriate for efficient computation. Spectral line intensities and profiles are reproduced accurately for the bands of symmetrical molecules. The model has the apparent limitation of producing lines of equal spacing. However, simple techniques are demonstrated for overcoming this limitation. The model has been generalized to include the Voigt profile equivalence of the Clough line shape which is important in the microwave region. Several applications are suggested such as improvements to the LOWTRAN atmospheric transmittance code and to emission and absorption modeling in general. Author (CISTI)

N91-30632 Defence Research Establishment Pacific, Victoria (British Columbia). Research and Development Branch.

CRUSTAL MAGNETIZATION AND GRADIENT TENSOR COMPONENT MAPS OF THE NORTHERN JUAN DE FUCA RIDGE

J. Bradley Nelson Nov. 1988 65 p

(DREP-TM-88-21; CTN-91-60210) Avail: NTIS HC A04

Magnetic gradient tensor component maps for an altitude of 300 m above sea-level have been generated from measurements of the horizontal derivative of the total-field over the northern end of the Juan de Fuca Ridge. They are digitized with a sampling interval of 148 m in the east direction and 222 m in the north direction. These maps contain geological information at higher frequencies than is possible by digitizing Geological Survey of Canada magnetic contour maps. As well, a model of the underlying magnetization has been developed from the total-field measurements. This model, when combined with bathymetric measurements of the area, may be used to calculate the total-field, its derivatives, and the tensor gradient components anywhere above the modelled area. The magnetization and bathymetry models are digitized at the same interval as the tensor component maps. Computer simulations of airborne magnetic anomaly detector (MAD) systems are being developed. These simulations require accurate models for the geological noise contribution to the magnetometer output. In addition, new geological environments can be modelled very easily with the Juan de Fuca magnetization and different bathymetry data. These new models are most easily and efficiently developed in the wavenumber domain. CISTI

N91-30633 Defence Research Establishment Pacific, Victoria (British Columbia). Research and Development Branch.

SPECTRAL ANALYSIS OF GEOLOGICAL MAGNETIC SIGNALS

Harold Wilson Oct. 1988 39 p

(DREP-TM-88-19; CTN-91-60211) Avail: NTIS HC A03

When applying magnetometers and magnetic gradiometers to magnetic anomaly detection (MAD), it is useful to understand the background signal due to geological sources and/or man made sources other than the anomaly of interest. This report derives the power spectrum of the signal from a magnetometer or a gradiometer moving in a straight line at a constant speed over a statistically stationary distribution of magnetic dipoles. (The most common example of such a distribution is magnetized rock.) The expressions for the power spectra presented here are related directly to the autocorrelation function for the magnetization density of the source distribution. The formulation presented here shows how to take into account the effect on the magnetic field of long-range correlations in source magnetization. Following the deduction of the connection between the magnetic sources and the power spectra, the mathematical procedures described in the report are applied to two examples of magnetic sources to show the results to be expected and to illustrate the problems that will be encountered in performing the calculations. Author (CISTI)

N91-30634*# California Univ., San Diego, La Jolla. Inst. of Geophysics and Planetary Physics.

STATISTICAL DESCRIPTION OF TECTONIC MOTIONS Progress Report, 1 Nov. 1990 - 30 May 1991

Duncan Carr Agnew 1991 12 p

(Grant NAG5-905)

(NASA-CR-188775; NAS 1.26:188775) Avail: NTIS HC/MF A03 CSCL 08E

The behavior of stochastic processes was studied whose power spectra are described by power-law behavior. The details of the analysis and the conclusions that were reached are presented. This analysis was extended to compare detection capabilities of different measurement techniques (e.g., gravimetry and GPS for the vertical, and seismometers and GPS for horizontal), both in general and for the specific case of the deformations produced

by a dislocation in a half-space (which applies to seismic of preseismic sources). The time-domain behavior of power-law noises is also investigated. Author

N91-30635# Swedish Inst. of Space Physics, Kiruna.
THE CONTRIBUTION OF THE BOUNDARY LAYER EMF TO MAGNETOSPHERIC SUBSTORMS
R. Lundin, I. Sandahl, J. Woch, and R. Elphinstone (Calgary Univ., Alberta) Jan. 1991 28 p Presented at Chapman Conference on Magnetospheric Substorms, Hakone, Japan, 3-7 Sep. 1990 Submitted for publication
(PB91-192740; IRF-Preprint-117; ETN-91-99500) Avail: NTIS HC/MF A03

The neutral line and boundary layer models to explain the triggering of substorms are discussed based on the EMF (Electromotive force) produced in the Low Latitude Boundary Layer (LLBL) as consequence of massive solar wind plasma injection there. The hypothesis stems from recent observations that the dayside oval is persistently active while the nightside oval is only temporarily active. Region 1 current system is argued to be divisable into two partial current circuits. One circuit, entirely coupled to the LLBL, is related to the continuously active dayside oval in the cleft region. The other circuit, connected to the nightside oval and the tail current sheet, can be considered a diversion or a tail route for currents driven by the LLBL. The advantage with the current concept proposed is that it allows for both a driven and loading/inloading mechanism for substorms. Auroral break up is in this model a consequence of enhanced currents, induced by solar wind pressure variations within the LLBL dynamo, that has reached nightside magnetic field lines of enhanced ionospheric conductivity. The model also allows for the development of tail plasmoids, generally assumed to be the consequence of a current diversion instability within the nightside current wedge. ESA

N91-30636# Loughborough Univ. of Technology (England). Dept. of Mathematical Sciences.
COLLIDING PLANE WAVE SPACE-TIMES
J. B. Griffiths May 1991 13 p
(Maths-Rept-A-145; ETN-91-99554) Avail: NTIS HC/MF A03

When two plane waves collide, it is shown that the metric in the interaction region is only the product of two 2 spaces in certain restricted cases which include gravitational and electromagnetic waves. The form of the metric in the completely general case is defined, and is illustrated for the case of colliding plane neutrino waves. Two classes of exact solutions, including the general case of pure neutrino waves, are given and some general properties are deduced. ESA

N91-30637*# Johns Hopkins Univ., Baltimore, MD. Dept. of Earth and Planetary Sciences.
THE EFFECT OF CLOUDS ON THE EARTH'S RADIATION BUDGET Progress Report
Daniel Ziskin and Darrell F. Strobel 24 Sep. 1991 21 p
(Grant NAG5-1476)
(NASA-CR-188804; NAS 1.26:188804) Avail: NTIS HC/MF A03 CSCL 04A

The radiative fluxes from the Earth Radiation Budget Experiment (ERBE) and the cloud properties from the International Satellite Cloud Climatology Project (ISCCP) over Indonesia for the months of June and July of 1985 and 1986 were analyzed to determine the cloud sensitivity coefficients. The method involved a linear least squares regression between co-incident flux and cloud coverage measurements. The calculated slope is identified as the cloud sensitivity. It was found that the correlations between the total cloud fraction and radiation parameters were modest. However, correlations between cloud fraction and IR flux were improved by separating clouds by height. Likewise, correlations between the visible flux and cloud fractions were improved by distinguishing clouds based on optical depth. Calculating correlations between the net fluxes and either height or optical depth segregated cloud fractions were somewhat improved. When clouds were classified in terms of their height and optical depth, correlations among all the radiation components were improved. Mean cloud sensitivities based on the regression of radiative fluxes against height and optical depth separated cloud types are presented. Results are compared to a one-dimensional radiation model with a simple cloud parameterization scheme. Author

N91-30364# Naval Ocean Systems Center, San Diego, CA. Ocean and Atmospheric Sciences Div.
OPTIMUM SPACE, TIME, AND FREQUENCY SAMPLING OF THE IONOSPHERE WITH ADVANCED DIGITAL IONOSONDES
Adolf K. Paul and David B. Sailors *In* AGARD, Use or Reduction of Propagation and Noise Effects in Distributed Military Systems 1990 8 p (For primary document see N91-30362 22-32)
Copyright Avail: NTIS HC/MF A13; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

47 METEOROLOGY AND CLIMATOLOGY

Includes weather forecasting and modification.

N91-30638# Naval Oceanographic and Atmospheric Research Lab., Bay Saint Louis, MS.
ENVIRONMENTAL CONDITIONS IN THE GULF OF MEXICO DURING NOVEMBER-DECEMBER Final Report
J. D. Boyd, L. A. Jugan, M. A. Rich, and B. J. Roser Oct. 1990 49 p
(AD-A229384; NOARL-TN-83) Avail: NTIS HC/MF A03 CSCL 08/3

Some of the environmental conditions are described that are in a region of the Gulf of Mexico in which an experiment will take place in November and December 1990. The general area of interest lies between 24 to 29 deg N and 90 to 95 deg W. The experiment location will be at or near 26 deg 40 min N, 92 deg 30 min W. A review is provided of the oceanographic and meteorological variables that may affect acoustic properties and deployed instrumentation during this experiment. Oceanographic and atmospheric characteristics for the area are presented, with specific emphasis on the conditions during November and December. GRA

N91-30639*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
OCEANIC TIDE MAPS AND SPHERICAL HARMONIC COEFFICIENTS FROM GEOSAT ALTIMETRY
D. E. Cartwright, R. D. Ray (ST Systems Corp., Lanham, MD.), and B. V. Sanchez Jul. 1991 79 p
(NASA-TM-104544; Rept-91B00073; NAS 1.15:104544) Avail: NTIS HC/MF A05; 2 functional color pages CSCL 04B

Maps and tables for the global ocean tides, 69 degree N to 68 degree S, derived from two years of Geosat altimetry are presented. Global maps of local and Greenwich admittance of the (altimetric) ocean tide, and maps of amplitude and Greenwich phase lag of the ocean tide are shown for M(sub 2), S(sub 2), N(sub 2), O(sub 1), and K(sub 1). Larger scale maps of amplitude and phases are also shown for regional areas of special interest. Spherical harmonic coefficients of the ocean tide through degree and order 8 are tabulated for the six major constituents. Author

N91-30640 Arizona Univ., Tucson.
ANALYSIS OF LIGHTNING FIELD CHANGES PRODUCED BY FLORIDA THUNDERSTORMS Ph.D. Thesis
William John Koshak 1990 195 p
Avail: Univ. Microfilms Order No. DA9111945

An interactive computer program was developed to compute accurate values of lightning-caused changes in the cloud electric field (delta E). The delta E's for individual discharges in eight Florida thunderstorms were analyzed using a nonlinear, least-squares minimization procedures and point charge (Q) and point, dipole (P) models of the change in cloud charge. In all storms, the high altitude P-vectors tend to point downward toward a narrow altitude band of Q-solutions that is centered at about 8 km; low altitude P-vectors tend to point upward toward the Q-region, and the P-vectors that are at the same altitude as the Q-solutions

tend to be horizontal. Because there are inherent limitations in the above least-squares analysis method and models, a new, fundamentally different approach for analyzing lightning field changes was developed. This method finds an optimum volume charge distribution on a grid of finite dimensions and resolution. With this linear approach, complex field change patterns subject to a variety of external constraints are able to be described. There is a framework in which a standard eigenanalysis can be used to access the general information content of data and the effects of measurement errors. Tests of the linear method with simulated lightning sources show that a centroid of the lightning charge distribution can be retrieved to within the grid resolution (2 km) when a Landweber iterative algorithm is used. Tests on three natural lightning events show that there is good agreement with previous Q- and P-model solutions and a reasonable result for one event that could not be described with either a Q- or a P-model. Dissert. Abstr.

N91-30641 Princeton Univ., NJ.
AN OBSERVATIONAL STUDY OF TROPICAL SUMMERTIME SYNOPTIC SCALE DISTURBANCES Ph.D. Thesis
Kai-Hon Lau 1991 252 p
Avail: Univ. Microfilms Order No. DA9116080

The distribution, spectral properties, 3-D structure, and propagation characteristics of tropical synoptic scale transients during the northern summer are studied with twice daily ECMWF global gridded analyses. Lag-correlation and regression statistics of the synoptic scale tropical fluctuations are examined. Sites of active transient activity are identified with enhanced vorticity variance, tele-connectivity and temporal coherence. Transient activity throughout the tropics is also investigated using Extended Empirical Orthogonal Function (EEOF) techniques. Using the EEOF time coefficients, the space-time evolution of selected meteorological variables for the disturbances in various tropical regions are composited. The relative importance of different dynamical processes in the local vorticity, eddy entrophy and kinetic energy balances are examined. Relationships between synoptic scale transients and severe cyclonic vortex-like systems are studied. By tracking local relative vorticity maxima in successive times and comparing them with tropical storm records in corresponding periods, it was found that about 20 to 30 pct. of the tracked disturbances in the western Pacific develop into tropical storms. Dissert. Abstr.

N91-30642 California Univ., Los Angeles.
THE COUPLING OF CUMULUS CONVECTION WITH LARGE-SCALE PROCESSES Ph.D. Thesis
Kuan-Man Xu 1990 277 p
Avail: Univ. Microfilms Order No. DA9117377

The extent to which cumulus convection can be parameterized deterministically and diagnostically (i.e., without introducing additional prognostic equations) for use in large scale prognostic models is one of the most basic questions in modeling the atmosphere. A series of numerical simulations were performed using a cumulus ensemble model (CEM). The CEM covers a large horizontal domain but can resolve individual clouds. A variety of convective cloud regimes are produced under different imposed large scale and surface conditions. A comparison of the statistical behavior of simulated cumulus convection with that observed is made in view of closure assumptions in cumulus parameterization. It is found that the behavior is statistically similar to that observed. Semi-prognostic tests of the Arakawa-Schubert cumulus parameterization are performed against the simulated data. These tests show that the parameterization is basically valid in spite of the existence of mesoscale organization. Further analyses of cloud scale variables indicate that there is in fact a quasi-equilibrium state. This state seems to be independent of the simulated cloud regimes and the grid size. Dissert. Abstr.

N91-30643 Michigan Univ., Ann Arbor.
A NUMERICAL ANALYSIS OF PLANE STRAIN DRAWING EMPLOYING EXPERIMENTALLY MEASURED TRACTION AS BOUNDARY CONDITIONS Ph.D. Thesis
Saeed David Kamia Barbat 1990 243 p
Avail: Univ. Microfilms Order No. DA9116119

The uncertainty of boundary conditions along the interface in metal forming forced many researchers to assume unrealistic friction models which do not represent the actual physical conditions along the interface. This problem is solved by measuring the exact variation of the friction coefficient along the interface in a strip-drawing process. New sapphire dies are used to obtain the tractions along the interface using a photoelasticity technique. Synthetic sapphire is hard enough to form commercial materials such as steel, aluminum, and copper, and makes the observations of the tribological features such as asperity flattening and lubricant entrapment at the die-workpiece interface possible. The normal and shear stress distributions in the die and along the contact region are determined from the isochromatic and isoclinic fringe patterns. It is concluded that transparent sapphire seems to be the only practical material that exhibits birefringent properties suitable for photoelasticity, and at the same time, its mechanical properties are comparable to those of the conventional die materials. Moire Interferometry is used and directed toward the study of the industrial application where tool steel dies and steel workpiece are used in a strip-drawing operation. The interfacial tractions are measured along the die-strip interface by using High-Sensitivity Moire Interferometry. The normal and shear strains along the contact surface of the die are determined and converted into the corresponding contact stresses. A finite-element code is modified to incorporate the measured tractions as prescribed boundary conditions. The finite element analysis is based on the rate formulation of the constitutive equations for an elastic-plastic isotropic work-hardening material with von Mises yield condition. The updated Lagrangian formulation is adopted in this code. Numerical predictions such as mesh distortion, metal flow, velocity distribution, and local stress and strain distributions are studied and compared to those obtained by other researchers.
Dissert. Abstr.

N91-30644 Colorado State Univ., Fort Collins.
NUMERICAL SIMULATION AND ANALYSIS OF THE PROPAGATION OF A PREFRONTAL SQUALL LINE Ph.D. Thesis
Jennifer Mary Cram 1990 349 p
Avail: Univ. Microfilms Order No. DA9117168

An observational and numerical study of the squall line that occurred on 17 to 18 Jun. 1978 is described. The squall line was initially triggered by the strong surface convergence along a cold front, but then propagated faster than, and out away from, the front. A numerical model is used to model the squall line development and propagation. Several sensitivity experiments were completed to test the sensitivity of the results to the use of the Kuo-type cumulus parameterization scheme and grid-scale microphysical processes. The simulations that included the cumulus parameterization scheme and grid scale latent heating effects accurately modeled the initial development of the squall line and its subsequent movement away from the front. The effects of varying the initial specifications of roughness length, soil texture, and soil moisture were also tested. The propagation of the squall line in the model is shown to be due to the propagation of a deep tropospheric internal gravity wave, in a wave-CISK-like process. The thermal and dynamic perturbations associated with the wave are shown to be consistent with gravity wave theory, and the characteristics of the wave are compared to similar results from wave-CISK studies. The propagation of the squall line as an internal gravity wave is also discussed in relation to other studies. The current literature favors the mechanism of gust front convergence to explain squall line propagation. It is suggested that a spectrum of scales of forcing may exist and be responsible for squall line propagation, but many models and observations may be able to detect only the gust-front-type processes. The dominant propagation mechanism in these modeling simulations was an internal gravity wave, and its seems reasonable that the gravity wave was at least one of the mechanisms responsible for

the actual propagation of the 17 to 18 Jun. 1987 squall line.
Dissert. Abstr.

N91-30645# Computer Sciences Corp., Monterey, CA.
EXPERCAT: AN EXPERT SYSTEM FOR ANALYSIS AND SHORT-TERM PREDICTION OF CLEAR AIR TURBULENCE Final Report
J. E. Peak Mar. 1991 34 p Sponsored by Naval Ocean Systems Center
(AD-A237588; NOARL-TN-101; AD-E040063) Avail: NTIS HC/MF A03 CSCL 04/2

An expert system approach to the analysis and short-term prediction of clear air turbulence (CAT) is presented. CAT is defined here as nonconvective turbulence occurring above 18,000 feet. ExperCAT is rule-based, contains a total of 65 rules and has extensive help and explanation features. The system's analysis procedure is to guide a human observer in identifying cloud signatures known to be associated with CAT. ExperCAT forecasts include an estimate of the turbulence intensity and a confidence factor. The user can optionally view the selections entered to arrive at the forecast. Three step-by-step example runs are provided. GRA

N91-30646*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
RAINFALL ESTIMATION OVER OCEANS FROM SCANNING MULTICHANNEL MICROWAVE RADIOMETER AND SPECIAL SENSOR MICROWAVE/IMAGER MICROWAVE DATA
C. Prabhakara, G. Dalu, G. L. Liberti, J. J. Nucciarone (ST Systems Corp., Lanham, MD.), and R. Suhasini Aug. 1991 69 p
(NASA-TM-104546; NAS 1.15:104546; Rept-91B00126) Avail: NTIS HC/MF A04 CSCL 04B

The brightness temperature (T sub b) measured at 37 GHz shows fairly strong emission from rain, and only slight effects caused by scattering by ice above the rain clouds. At frequencies below 37 GHz, were the fov is larger and the volume extinction coefficient is weaker, it is found that the observations do not yield appreciable additional information about rain. At 85 GHz (fov = 15 km), where the volume extinction is considerably larger, direct information about rain below the clouds is usually masked. Based on the above ideas, 37 GHz observations with a 30 km fov from SMMR and SSM/I are selected to develop an empirical method for the estimation of rain rate. In this method, the statistics of the observed T sub b's at 37 GHz in a rain storm are related to the rain rate statistics in that storm. The underestimation of rain rate, arising from the inability of the radiometer to respond sensitively to rain rate above a given threshold, is rectified in this technique with the aid of two parameters that depend on the total water vapor content in the atmosphere. The retrieved rain rates compare favorably with radar observations and monthly mean global maps of rain derived from this technique over the oceans. Author

N91-30647# National Weather Service, Honolulu, HI.
THE 1990 TROPICAL CYCLONES: CENTRAL NORTH PACIFIC
Andrew K. T. Chun, Raymond T. Martin, and Hans E. Rosendal Apr. 1991 36 p
(PB91-184564; NOAA-TM-NWSTM-PR-36) Avail: NTIS HC/MF A03 CSCL 04B

Data is presented for the Central North Pacific Tropical Cyclone data, 1990. Other data presented include the following: tropical storm AKA; tropical storm AKA - 24 hour forecast verification; tropical storm AKA - 36 hour forecast verification; tropical storm AKA 48 hour forecast verification; tropical storm AKA - 72 hour forecast verification; tropical depression TWO-C; hurricane Marie; hurricane Marie - 24 hour forecast verification; hurricane Marie - 36 hour forecast verification; hurricane Marie - 48 hour forecast verification; hurricane Marie - 72 hour forecast verification; tropical storm POLO; 1990 forecast verification summary. GRA

N91-30648# Environmental Protection Agency, Research Triangle Park, NC. Atmospheric Research and Exposure Assessment Lab.
WIND FIELD DEVELOPMENT FOR THE EPA REGIONAL OXIDANT MODEL
C. J. Coats and K. L. Schere 1991 18 p Presented at the 84th Annual Meeting of the Air and Waste Management Association, Vancouver, British Columbia, 16-21 Jun. 1991 Prepared in cooperation with Computer Sciences Corp., Research Triangle Park, NC, and National Oceanic and Atmospheric Administration, Research Triangle Park, NC
(PB91-191213; EPA/600/D-91/084) Avail: NTIS HC/MF A03 CSCL 04B

Regional scale (approximately 1000 km) air quality simulation models require hourly inputs of u and v wind components for each vertical layer of the model and for each grid cell in the horizontal. The standard North American meteorological observation network is used to derive the wind field inputs for the Regional Oxidant Model (ROM) and other regional models. While a fairly dense surface network with hourly observations exists, upper air data are obtained only twice per day at monitoring sites typically separated by 300 to 500 km distances. Using these data to derive the more spatially and temporally resolved gridded wind fields needed by the ROM introduces uncertainties and errors into the model. The authors present a method of developing gridded wind fields for the ROM that accounts for these non-deterministic features. The method produces a family of potential gridded wind fields allowing for the stochastic nature of the interpolation process. Examples of the derived wind fields are given for the Northeast U.S. Potential differences between the wind fields, in terms of their effects on air quality modeling, are inferred from following multi-day flow trajectories using various members of the wind field family. GRA

N91-30649# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
ANALYSIS OF LONG WAVE DISTURBANCES IN THE EAST OVER THE SOUTHERN EQUATORIAL ATLANTIC OCEAN M.S. Thesis [ANALISE DE DISTURBIOS ONDULATORIOS DE LESTE SOBRE O OCEANO ATLANTICO EQUATORIAL SUL]
Chou Sin Chan Dec. 1990 121 p In PORTUGUESE; ENGLISH summary
(INPE-5222-TDL/437) Avail: NTIS HC/MF A06

The National Meteorological Center (NMC) daily data and Outgoing Longwave Radiation (OLR) data was used to investigate the main features of wave disturbances over the Equatorial Atlantic Ocean in the vicinity of South America, during the First GARP Global Experiment (FGGE). Hovmoller diagrams and spectrum analysis of the meridional component of wind at 850 hPa were used to estimate the time scale and the propagation features of wave disturbances. Analysis of Hovmoller diagrams reveal, throughout the year, the existence of waves propagating westward with a period of 5-6 days, phase speed of 10-12 m/s, and wavelength of about 4800-6200 km. During the southern autumn the waves are relatively short, while during the southern winter the waves are relatively long. During these seasons, the amplitude of the waves are relatively longer than during the other seasons. These disturbances are only weakly observed in OLR data, while disturbances of 10-30 days and 30-60 days were more evident. The power spectra of the meridional wind component show peaks between 3-5 days over the Atlantic Ocean at 5 degrees S. These peaks are more prominent during autumn and winter and at about 20 degrees W and 25 degrees W. Cross spectra indicate waves traveling westwards at a speed of 9.5 m/s and a wavelength of 3300 km during southern autumn, and at a phase speed of 15 m/s and a wavelength of about 5200 km during southern winter.
Author

N91-30650# World Meteorological Organization, Geneva (Switzerland).
EXTREMES AND DESIGN VALUES IN CLIMATOLOGY World Climate Applications Programme
Tibor Farago and Richard W. Katz (National Center for Atmospheric

Research, Boulder, CO.) Sep. 1990 51 p
(WCAP-14; WMO/TD-386) Avail: NTIS HC/MF A04; print copy available at WMO, Geneva, Switzerland

The conceptual background of extreme value analysis is briefly reviewed, and then statistical methods for the estimation of extremal characteristics and design values for climatological elements are more extensively described. To provide practical guidance regarding the application of these statistical estimation techniques to extreme climatological events, several examples are presented. A computer program for the calculations involved is described. Author

N91-30651# Colorado State Univ., Fort Collins. Dept. of Atmospheric Science.
AN OBSERVATIONAL ANALYSIS OF TROPICAL CYCLONE RECURVATURE
Stephen J. Hodanish and William M. Gray May 1991 134 p
(Contract N00014-87-K-0203)
(ASP-480) Avail: NTIS HC/MF A07

North Pacific rawinsonde data are used to show how the large scale synoptic pattern interacts with the tropical cyclones' environment just prior to, and during the recurvature process. It was qualitatively examined how the environmental wind fields at all levels of the troposphere are related to tropical cyclone motion prior to, and during recurvature. Significant changes in the upper tropospheric zonal wind fields were found to the north and northwest of tropical cyclones one to two days prior to beginning recurvature. A recurvature forecasting scheme was also developed using the environmental windfields measured in the northwest region of the cyclone. This scheme was found to be generally successful. Author

N91-30652 Physics and Electronics Lab. TNO, The Hague (Netherlands).
CLOUD BASE MONITORING WITH LIDAR Final Report
G. J. Kunz Jan. 1991 41 p
(Contract A83/K/58)
(FEL-90-A315; TD-90-4047; ETN-91-99814) Copyright Avail: Physics and Electronics Lab. TNO, P.O. Box 96864, 2509 JG The Hague, Netherlands

A lidar is used to determine cloud base (during a two year period) on a semi continuous base. Cloud base is here defined as the altitude at which a cloud reflection is observed in the lidar signal. The maximum altitude at which clouds are detected is 6 km. Both numerical simulations and measurements show that lidar is not always able to detect the presence of a cloud from a reflected pulse. A more reliable method to determine cloud base with lidar is to solve the lidar equations for the measured vertical return signal to attain an extinction or backscatter profile in which cloud base can be determined from a threshold criterium. ESA

N91-30653# International Meteorological Inst., Stockholm (Sweden).
[ACTIVITIES REPORT OF THE INTERNATIONAL METEOROLOGICAL INSTITUTE] Annual Report, Jul. 1989 - Jun. 1990
1990 72 p
(ISSN-0349-0068; ETN-91-99550) Avail: NTIS HC/MF A04

The objective of the International Meteorological Institute in Stockholm (Sweden) is to conduct research in meteorology and associated fields and to promote international scientific cooperation within meteorology. The Institute provides possibilities for foreign scientists to work in Sweden in close collaboration with their Swedish colleagues. Details of the following are included in this report: international activities; research activities (dynamics meteorology, chemical meteorology and biogeochemistry, atmospheric physics, atmospheric aerosol science); visiting scientists; finances. A list of publications and reports, and a list of acronyms are given. ESA

48 OCEANOGRAPHY

Includes biological, dynamic, and physical oceanography; and marine resources.

For related information see also *43 Earth Resources and Remote Sensing.*

N91-30654# Massachusetts Inst. of Tech., Cambridge. Dept. of Earth Atmospheric and Planetary Sciences.
STUDIES TOWARD OBSERVING AND MODELLING LARGE ENERGETIC OCEAN REGIONS Final Report, 1 Oct. 1985 - 30 Jun. 1990
Carl Wunsch 27 Nov. 1990 4 p
(Contract N00014-85-J-1241)
(AD-A229478) Avail: NTIS HC/MF A01 CSCL 08/3

The high energy region near the Gulf Stream system was studied. A list of publications is presented. Included topics are acoustic tomography, modelling, altimetry and scatterometry. GRA

N91-30655# Pacific Missile Test Center, Point Mugu, CA.
TIDAL AND LUNAR DATA FOR POINT MUGU, SAN NICHOLAS ISLAND, AND THE BARKING SANDS AREA DURING 1991
Charles Fisk 31 Dec. 1990 36 p
(AD-A229479; PMTC-TP-000052) Avail: NTIS HC/MF A03 CSCL 08/3

Basic lunar and tidal data for Point Mugu, San Nicolas Island and the Barking Sands Area during 1990 are provided. The data presented are tidal data, times of moonrise and moonset, times of lunar phases, and times of sunrise and sunset. GRA

N91-30656# Coastal Engineering Research Center, Vicksburg, MS.
COMPARISON OF ATLANTIC COAST WAVE INFORMATION STUDY HINDCASTS WITH FIELD RESEARCH FACILITY GAGE MEASUREMENTS Final Report
Herman C. Miller and Robert E. Jensen Oct. 1990 36 p
(AD-A229515; CERC-90-17) Avail: NTIS HC/MF A03 CSCL 08/3

This report compares summaries of the 1956 to 1975 Atlantic coast Phase 3 shallow-water Wave Information Studies (WIS) estimates with two measured data sets from the Coastal Engineering Research Center's Field Research Facility (FRF) at Duck, NC. The first consists of 5 years of energy spectra from a Waverider buoy, while the second is 1 year of directional spectra from a high-resolution linear array. Results of the study provide the engineer with a clear understanding of the differences between the WIS estimates and the FRF measurements that will help ensure the appropriate application of the WIS wave information. Following a description of the WIS estimates and the FRF measurements, wave period, height, and direction summaries are compared. The wave periods did not compare well, whereas wave heights did. The wave direction comparison is less conclusive; however, net longshore sediment transport estimates made using the WIS estimates are very close to that using the FRF measurements. GRA

N91-30657# University of South Alabama, Mobile.
ESTIMATING RUNUP ON BEACHES: A REVIEW OF THE STATE OF THE ART Final Report
Scott L. Douglas Oct. 1990 80 p
(Contract DACW39-89-M-3481)
(AD-A229516; CERC-90-3) Avail: NTIS HC/MF A05 CSCL 08/3

The literature of estimating extreme values of runup on beaches is reviewed. The few available models for estimating beach runup agree with each other and the available data. However, the models are of limited engineering usefulness. Also, the available data are significantly limited. The use of Hunt's Equation to scale beach runup should be carefully examined. Future research on beach runup is recommended and the importance of the engineering applications of such research is outlined. GRA

N91-30658# Institute for Naval Oceanography, Bay Saint Louis, MS.
USER'S MANUAL FOR A PRIMITIVE EQUATION REGIONAL OCEAN-CIRCULATION MODEL
Katherine S. Hedstrom Jul. 1990 93 p
(AD-A234979; INO-SR-1; INO-TN-FY90-2) Avail: NTIS HC/MF A05 CSCL 12/5

This user's manual for the semi-spectral primitive equation model (SPEM) attempts to describe the model equations as well as what the user has to do to configure the model for a specific application. The principle attributes of the model are as follows: (A) General - (1) Primitive equations with temperature, salinity and an equation of state; (2) Hydrostatic and Boussinesq approximations; (3) Second-moment conservation; (4) Optional Lagrangian floats; (B) Horizontal - (1) Orthogonal-curvilinear coordinates; (2) Arakawa C grid; (3) Periodic channel or user supplied boundary conditions; and (C) Vertical - (1) Sigma(bottom-topography following) coordinate; (2) Chebyshev modal expansion, (3) Rigid lid on top. GRA

N91-30659# Old Dominion Univ., Norfolk, VA. Dept. of Oceanography.
MESOSCALE CHARACTERISTICS AND THE ROLE OF DEFORMATION ON OCEAN DYNAMICS Final Report, 1 Oct. 1987 - 31 Jan. 1989
Albert D. Kirwan, Jr. 5 Jun. 1991 29 p
(Contract N00014-88-K-0203)
(AD-A237123) Avail: NTIS HC/MF A03 CSCL 08/3

The bulk of the research activities conducted under this contract consists of basic research on ocean flow dynamics as it pertains to the prediction of ocean motion. The following three papers, describing aspects of the research and published in the adjudicated scientific literature are included in this report: Genesis of the Gulf of Mexico ring as determined from kinematic analysis; observed and simulated kinematic properties of loop current rings; and notes on the cluster method for interpreting relative motions. GRA

N91-30660# National Marine Fisheries Service, Monterey, CA. Pacific Fisheries Environmental Group.
NEARSHORE PHYSICAL OCEANOGRAPHY OFF THE CENTRAL CALIFORNIA COAST DURING MAY-JUNE, 1989: A SUMMARY OF CTD DATA FROM JUVENILE ROCKFISH SURVEYS
F. B. Schwing, S. Ralston, D. M. Husby, and W. H. Lenarz Dec. 1990 149 p
(PB91-191817; NOAA-TM-NMFS-SWFSC-153) Avail: NTIS HC/MF A07 CSCL 08C

Results are summarized which were obtained from the Conductivity-Temperature-Depth (CTD) data collected in 1989. Due to the large quantity of data analyzed and the extensive array of results presented, no attempt is made to provide detailed interpretations of the findings. Also, the reader is referred to a companion volume (Schwing and Ralston 1990), which contains individual traces of temperature, salinity, and density plotted against depth for each CTD cast conducted. Author

N91-30661# New Hampshire Univ., Durham. Ocean Process Analysis Lab.
STUDY OF THE CCCCS PRESSURE FIELD AND ITS RELATION TO CIRCULATION
W. S. Brown May 1990 76 p Sponsored in part by Minerals Management Service, Los Angeles, CA
(Contract DI-14-35-0001-30474)
(PB91-192617; OCS/MMS-90/0021) Avail: NTIS HC/MF A05 CSCL 08C

The objectives of the report were: (1) to describe the temporal and spatial structure of the pressure and pressure gradient fields along the Central California continental margin during the CCCCS program; (2) to develop a conceptual understanding of the relationships among wind stress, pressure gradients, and alongshore and across-shore transports; and (3) to assess the feasibility of using coastal sea level as a proxy for flow variability over the Central California continental margin. NDBC buoy alongshelf windstress forcing accounts for only about 30 percent of the variance of the CCCCS synthetic subsurface pressure (SSP) observations. The percentage of wind-driven variance explained by the principal alongshelf wind stress model increased to 52 percent when only the SSP records from the 100 m isobath and shoreward are considered. At 2- to 4-day fluctuation periods, the alongshelf and across-shelf SSP differences at or near the coast are significantly more energetic than the corresponding SSP differences. This difference can be ascribed to the distinctly more energetic coastal SSP 's at these periods. At these frequencies, the SSP difference energy is highly organized (i.e., coherent) throughout the CCCCS region, with 80 percent of the variance explained by the primary frequency-domain EOFs. Curiously, these high-frequency SSP difference EOF's are not coherent with NDBC buoy alongshelf wind stress. A comparison of observed and nearshore alongshelf geostrophic current fluctuations inferred from pressure measurements suggests that the magnitudes of the geostrophic currents are too large. GRA

N91-30662# Institute of Oceanographic Sciences, Wormley (England). Deacon Lab.
MICRONEKTONIC BIOMASS IN THE NORTH ATLANTIC
P. M. Hargreaves and P. R. S. Green (Imperial Coll. of Science and Technology, London, England) 1990 101 p
(IOS-280-1990; ETN-91-99782) Avail: NTIS HC/MF A06; Institute of Oceanographic Sciences, Deacon Lab., Wormley, Godalming, Surrey GU8 5UB, England, HC 26 sterling pounds

The vertical and horizontal distribution of micronektonic biomass in the North Atlantic Ocean is described based on data from net sampling carried out during 1969 to 1988. The data, drawn from samples taken with Rectangular Midwater Trawls (RMT) 8, include vertical distribution data from various stations located between the equator and 60 degrees N (North) 20 degrees to 25 degrees W (West). Samples were also taken at several stations in the vincinity of the Azores front; at five stations from off Bermuda to 54 degrees N including a series of repeated hauls at 1000 m, and at three other stations between 39 degrees N and 46 degrees N where seasonal fronts occur; at one station at 31 degrees N and 25 degrees W and another at 47 degrees N 19 degrees W. Further data are derived from repeated hauls and a vertical series at 44 degrees N 13 degrees W and from two transects of oblique hauls. Total micronektonic biomass concentrations, based on wet displacement volume, throughout the top 1000 m of the water column tended to be greatest close to the equator at 20 degrees W near the NW African Upwelling area, and to the north of approximately 41 degrees N. Relatively low biomass concentrations were recorded between 30 degrees N and 40 degrees N. ESA

N91-30663# Institute of Oceanographic Sciences, Wormley (England). Deacon Lab.
STATION DATA FOR THE IOS BENTHIC BIOLOGICAL SURVEY OF THE PORCUPINE SEABIGHT REGION (NE ATLANTIC) 1977-1989
P. A. B. Jackson, M. H. Thurston, and A. L. Rice 1991 86 p
(IOS-281-1991; ETN-91-99783) Avail: NTIS HC/MF A05; Institute of Oceanographic Sciences, Deacon Lab., Wormley, Godalming, Surrey GU8 5UB, England, HC 23 sterling pounds

Station data for benthic and near bottom samples taken within the IOS (Institute of Oceanographic Sciences) benthic biology program in the Porcupine Seabight and on the adjacent Porcupine Abyssal Plain between 1977 and 1989 is summarized. During the years 1977 to 1986 inclusive, 24 cruises devoted entirely or in part to benthic biology visited the area. Since 1986, the program focused more an abyssal studies and little collecting effort was expended on the Seabight area. Such stations as have been worked are included in the data listed. ESA

N91-30664# Institute of Oceanographic Sciences, Wormley (England). Deacon Lab.
CTDO AND NUTRIENT DATA FROM CHARLES DARWIN CRUISE 50 IN THE ICELAND FAEROES REGION
P. M. Saunders, W. John Gould, D. J. Hydes, and M. A. Brandon 1991 73 p

(IOS-282-1991; ETN-91-99784) Avail: NTIS HC/MF A04; Institute of Oceanographic Sciences, Deacon Lab., Wormley, Godalming, Surrey GU8 5UB, England, HC 20 sterling pounds

Hydrographic data taken between Iceland and the Faeroe Islands aboard RRS Charles Darwin on cruise 50 (29 Jun. to 22 Jul. 1990) is presented. Fifty seven stations were occupied in two major and three minor sections to examine the exchange of water between the Iceland and Norwegian basins. The processing of Charge Transfer Device (CTD) data up to the archive stage, including calibration and field verification, is described in some detail. Sample data (salinity, oxygen and nutrients, 2 sets) were also collected and reproducibility is assessed from the duplicate values. For about 450 samples the reproducibility of salinity measurements is determined as better than 0.001, and for oxygen it is approximately 0.01 m/l. For nitrate, silicate and phosphate the figures are 0.04, 0.4 , 0.07 micromol/kg respectively. A brief comparison is made between the nutrient data from this cruise and a historic set. The bulk of the report is given over the plots and lists of the observations. Sections plots for ten variables (both CTD and sample data) are presented revealing the location and characteristics of the Norwegian Sea overflow. Lists of all sample measurements are printed. ESA

N91-30665# Proudman Oceanographic Lab., Birkenhead (England).
THE HEAT BALANCE OF THE NORTH SEA
A. Lane 1989 45 p
(Rept-8-1989; ETN-91-99468) Avail: NTIS HC/MF A03; Proundman Oceanographic Lab., The Library, Bidston Observatory, Birkenhead, Merseyside L43 7 RA, England, HC 14 Sterling pounds

Equations from Goldsmith and Bunker which describe the heat exchange processes between the sea surface and the atmosphere are presented. The component parts of these equations involve: the solar radiation at the sea surface; the latent heat flux; the effective infrared back radiation; and the sensible heat flux. The dependence of these equations on certain parameters is examined, with the intention of using them in simulating the heat balance of the North Sea. Using parameter values appropriate to the North Sea, the sensitivity of the net annual heat flux is analyzed for small perturbations from these mean values. This analysis shows that overall, the difference between mean air and sea surface temperature is of vital importance. It is shown that a change in mean air temperature of 1 C is likely to be accompanied by a 0.5 C change in mean sea surface temperature. An interesting result was found concerning the variation in the solar radiation flux with both latitude and season. Thus, at its maximum in July, this component shows little north south variation within the North Sea dimensions; while at its minimum in January, the southern limit receives appreciably more energy. ESA

N91-30666# Institut National Polytechnique, Grenoble (France). Lab. de Modelisation et Calcul.
STUDY AND PARALLELIZATION OF FINITE ELEMENT CODE FOR QUASI GEOSTROPHIC MODELING OF OCEAN CIRCULATIONS Ph.D. Thesis [ETUDE ET PARALLELISATION D'UN CODE D'ELEMENTS FINIS POUR LA MODELISATION QUASI-GEOSTROPHIQUE DES CIRCULATIONS OCEANIQUES]
Christine Bernier 1990 175 p In FRENCH
(ETN-91-99486) Avail: NTIS HC/MF A08

A finite element code was realized and studied for wind driven ocean circulations in a closed basin at mean latitudes. Two physical models were considered: the barotropic model with constant density ocean, as proposed in 1982, and an extension of this model to a density stratified ocean. In both cases the theoretical study demonstrated the existence and uniqueness of the solution of the equation system. Finite element method allows complex geometry fields which made possible the experimentation of the barotropic model on a realistic basin: the North Atlantic Ocean. The modeling code of barotropic and baroclinic circulations was tested on a square basin composed of three variable density layers. The results of simulations carried out were compared with those obtained by using a finite difference code. ESA

51 LIFE SCIENCES (GENERAL)

N91-30667* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
HORIZONTALLY ROTATED CELL CULTURE SYSTEM WITH A COAXIAL TUBULAR OXYGENATOR Patent
David A. Wolf, inventor (to NASA), Ray P. Schwarz, inventor (to NASA), and Tinh T. Trinh, inventor (to NASA) (Krug International, Houston, TX.) 25 Jun. 1991 17 p Filed 30 Jun. 1988
(NASA-Case-MSC-21294-1; US-Patent-5,026,650; US-Patent-Appl-SN-213558; US-Patent-Class-435-286; US-Patent-Class-435-285; US-Patent-Class-435-312; US-Patent-Class-435-313; US-Patent-Class-435-818; US-Patent-Class-261-83; Int-Patent-Class-C12M-3/02) Avail: US Patent and Trademark Office CSCL 06C

The present invention relates to a horizontally rotating bioreactor useful for carrying out cell and tissue culture. For processing of mammalian cells, the system is sterilized and fresh fluid medium, microcarrier beads, and cells are admitted to completely fill the cell culture vessel. An oxygen containing gas is admitted to the interior of the permeable membrane which prevents air bubbles from being introduced into the medium. The cylinder is rotated at a low speed within an incubator so that the circular motion of the fluid medium uniformly suspends the microbeads throughout the cylinder during the cell growth period. The unique design of this cell and tissue culture device was initially driven by two requirements imposed by its intended use for feasibility studies for three dimensional culture of living cells and tissues in space by JSC. They were compatible with microgravity and simulation of microgravity in one G. The vessels are designed to approximate the extremely quiescent low shear environment obtainable in space. Official Gazette of the U.S. Patent and Trademark Office

N91-30668*# California Univ., San Diego, La Jolla. Div. of Physiology.
COSMOS 2044: LUNG MORPHOLOGY STUDY, EXPERIMENT K-7-28 Final Report, 1 Oct. 1988 - 30 Sep. 1991
Ann R. Elliott, Odile Mathieu-Costello, and John B. West 1991 13 p
(Grant NAG2-616)
(NASA-CR-187711; NAS 1.26:187711) Avail: NTIS HC/MF A03 CSCL 06C

Researchers examined the effect of microgravity during spaceflight on lung tissue. The ultrastructure of the left lungs of 5 Czechoslovakian Wister rats flown on the 13 day, 19+ hour Cosmos 2044 mission was examined and compared to 5 vivarium and 5 synchronous controls at 1-g conditions, and 5 rats exposed to 14 days of tail suspension. Pulmonary hemorrage and alveolar adema of unknown origin occurred to a greater extent in the flight, tail-suspended, and synchronous control animals, and in the dorsal regions of the lung when compared with the vivarium controls. The cause of these changes, which are possibly due to an increase in pulmonary vascular pressure, requires further investigation. Author

N91-30669* Lockheed Engineering and Sciences Co., Washington, DC.
USSR SPACE LIFE SCIENCES DIGEST, ISSUE 31
Lydia Razran Hooke, ed., Ronald Teeter, ed., Victoria Garshnek, ed., and Joseph Rowe, ed. Washington NASA Jan. 1990 116 p
(Contract NASw-4292)
(NASA-CR-3922(37); NAS 1.26:3922(37)) Avail: NTIS HC A06/MF A01 CSCL 06C

This is the thirty first issue of NASA's Space Life Sciences Digest. It contains abstracts of 55 journal papers or book chapters published in Russian and of 5 Soviet monographs. Selected

abstracts are illustrated with figures and tables from the original. The abstracts in this issue have been identified as relevant to 18 areas of space biology and medicine. These areas include: adaptation, biological rhythms, cardiovascular and respiratory systems, endocrinology, enzymology, genetics, group dynamics, habitability and environmental effects, hematology, life support systems, metabolism, microbiology, musculoskeletal system, neurophysiology, nutrition, operational medicine, psychology, radiobiology, and space biology and medicine. Author

N91-30673# Joint Publications Research Service, Arlington, VA.
STATUS OF LIPID PEROXIDATION SYSTEM IN RAT TISSUES AFTER 7-DAY FLIGHT ON KOSMOS-1667 Abstract Only
N. V. Delenyan and A. A. Markin *In its* JPRS Report: Science and Technology. USSR: Life Sciences 25 Oct. 1990 p 1 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 23, no. 4, Jul.-Aug. 1989 p 34-37 (For primary document see N91-30670 22-52)
Avail: NTIS HC/MF A04

N91-30674# Joint Publications Research Service, Arlington, VA.
BLOOD ELECTROLYTE BALANCE IN DOGS REPEATEDLY EXPOSED TO +G(SUBz) ACCELERATION Abstract Only
R. A. Vartbaronov, G. D. Glod, I. G. Popov, N. N. Uglova, N. N. Sarycheva, and I. S. Rolik *In its* JPRS Report: Science and Technology. USSR: Life Sciences 25 Oct. 1990 p 2 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 23, no. 4, Jul.-Aug. 1989 p 43-46 (For primary document see N91-30670 22-52)
Avail: NTIS HC/MF A04

52 AEROSPACE MEDICINE

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

N91-30670# Joint Publications Research Service, Arlington, VA.
JPRS REPORT: SCIENCE AND TECHNOLOGY. USSR: LIFE SCIENCES
25 Oct. 1990 56 p Transl. into ENGLISH from various Russian articles
(JPRS-ULS-90-018) Avail: NTIS HC/MF A04

Translated articles are presented from Russian scientific publications in the general area of life sciences. Some more specific areas of discussion are as follow: aerospace medicine; agricultural science; biochemistry; biotechnology; genetics; immunology; industrial medicine; microbiology; nonionizing radiation effects; public health; and radiation biology. Some representative titles are as follow: Blood electrolyte balance in dogs repeatedly exposed to +G sub z acceleration; Variable productivity of winter wheat under dry conditions; Killer protein formed by Hansenula anomala (Hansen) H. Et P. Sydow; Construction of family of artificial human insulin genes; Cloning of chloroplast psbA and rbcL genes of Gossipium Hirsutum Cotton; Modeling of universal bone marrow by monoclonal antibodies; A method of classifying the toxicology parameters of toxic compounds; and Utilization of dimethylterephthalate by Rhodococcus Erythropolis. For individual titles, see N91-30671 through N91-30678.

N91-30671# Joint Publications Research Service, Arlington, VA.
FEEDING THE SALYUT-7 CREWS Abstract Only c54
V. P. Bychkov, S. Kalandarov, A. N. Agureyev, I. G. Popov, A. N. Kochetkova, and A. S. Ushakov *In its* JPRS Report: Science and Technology. USSR: Life Sciences 25 Oct. 1990 p 1 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 23, no. 4, Jul.-Aug. 1989 p 9-14 (For primary document see N91-30670 22-52)
Avail: NTIS HC/MF A04

The food products developed for the Salyut-7 crews consists primarily of dehydrated products to be rehydrated with hot or cold water before consumption. They are to be served in four meals a day on a six day menu. The daily ration contains approx. 130 g protein, 120 g fat, 360 g carbohydrates, for a total of 3000 calories. The crews takes multivitamins twice a day. Over the course of five missions on the orbital craft, a broad assortment of products and dishes was brought to the crews by the Progress freighters and the Soyuz-T craft, to supplement the regular menu. Some of the results are discussed of a physiological hygienic evaluation of the food rations supplied to the crews of five long duration Salyut-7 missions ranging from 126 to 211 days in length. Analysis of a 68 day preflight test of the rations and of the five missions aboard the Salyut-7 indicated that all components of the food operations functioned as intended and were generally well thought of by the cosmonauts. The daily diet kept the cosmonauts strong enough to perform their jobs. Author

N91-30672# Joint Publications Research Service, Arlington, VA.
REACTION OF SYMPATHOADRENAL SYSTEM OF COSMONAUTS AFTER LONG MISSIONS ON SALYUT-7 ORBITAL SPACECRAFT Abstract Only
N. A. Davydova, R. Kvetnyanski, and A. S. Ushakov *In its* JPRS Report: Science and Technology. USSR: Life Sciences 25 Oct. 1990 p 1 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 23, no. 4, Jul.-Aug. 1989 p 14-20 (For primary document see N91-30670 22-52)
Avail: NTIS HC/MF A04

Because the sympathoadrenal system is an important component of neurohumoral regulation, study of its hormonal and mediator component is especially important for long duration spaceflights, when the body is exposed to extreme conditions and the ability to adapt to such conditions determines, to a large extent, the success and completion of the mission. A broad spectrum of sympathoadrenal activity indicators are used to study catecholamine metabolism in cosmonauts after missions of 211 and 237 days, as well as during the missions. Analysis of the sympathoadrenal activity showed the hormonal component to have been stimulated, with the adrenaline/noradrenaline ratio twice as high as the preflight ratio. The transmitter component activity was inhibited, such that noradrenaline synthesis was low on the day of the landing, after which it gradually rose. Dopamine synthesis behaved in an opposite manner. Author

N91-30673# Joint Publications Research Service, Arlington, VA.
STATUS OF LIPID PEROXIDATION SYSTEM IN RAT TISSUES AFTER 7-DAY FLIGHT ON KOSMOS-1667 Abstract Only c51
N. V. Delenyan and A. A. Markin *In its* JPRS Report: Science and Technology. USSR: Life Sciences 25 Oct. 1990 p 1 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 23, no. 4, Jul.-Aug. 1989 p 34-37 (For primary document see N91-30670 22-52)
Avail: NTIS HC/MF A04

A study is made of the levels of lipid peroxidation products (diene conjugates, Schiff bases and malonic dialdehyde), the activity of basic antioxidant enzymes (superoxidismutase, catalysis, gluthatione peroxidase, glutathione reductase), and the bioantioxidants tocopherol (vitamin E) in the tissues of rats after a seven day flight on board the Kosmos-1667 satellite. The data obtained indicated a generalized increase in lipid peroxidation in the livers of rats, increasing the permeability of cell membranes. Reliable increases were observed in the activity of the cytoplasmic enzyme of the heptocytes with a simultaneous increase in general antioxidant activity. These changes, plus a milder increase in lipid peroxidation products in the myocardium, indicate that the intensification of lipid peroxidation probably results from the altered gravitation. Author

N91-30674# Joint Publications Research Service, Arlington, VA.
BLOOD ELECTROLYTE BALANCE IN DOGS REPEATEDLY EXPOSED TO +G(SUBz) ACCELERATION Abstract Only c51
R. A. Vartbaronov, G. D. Glod, I. G. Popov, N. N. Uglova, N. N. Sarycheva, and I. S. Rolik *In its* JPRS Report: Science and

Technology. USSR: Life Sciences 25 Oct. 1990 p 2 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 23, no. 4, Jul.-Aug. 1989 p 43-46 (For primary document see N91-30670 22-52)
Avail: NTIS HC/MF A04

A study was made of the dynamics of the concentration of K(+), Na(+), Mg(++), and Ca(++) in the blood plasma of animals during exposure to the maximum tolerated acceleration +G sub z of increasing intensity, as well as the possible antiarrhythmic effect of hypermagnesemia under these conditions. Centrifuge experiments were performed on seven mongrel dogs, with exposure once or twice per week over a period of five months, with increasing acceleration to the point of appearance of cardiac rhythm disorders. Blood samples were taken two to three days after each acceleration exposure. Hypermagnesemia was achieved by i/m injection of a 25 pct. magnesium sulfate solution, dose 0.5 ml/kg. The experiments produced persistent hypermagnesemia and hyperkaliemia of a compensatory nature, decreasing the loss of K(+) ions and increasing acceleration tolerance by 1.5 g.
Author

N91-30675# Joint Publications Research Service, Arlington, VA.
INFLUENCE OF LONG-TERM ANTIORTHOSTATIC HYPOKINESIA ON ACTIVITY OF ENZYMES INVOLVED IN ENERGY AND PLASTIC METABOLISM Abstract Only
I. P. Popova, Ye. G. vetrova, and T. Ye. Drozdova *In its* JPRS Report: Science and Technology. USSR: Life Sciences 25 Oct. 1990 p 2 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 23, no. 4, Jul.-Aug. 1989 p 51-55 (For primary document see N91-30670 22-52)
Avail: NTIS HC/MF A04

Studies of human blood serum enzyme activity are of interest not only for diagnostic purposes, but also as a method of studying the specifics of human metabolism under extreme conditions. A dynamic study is presented of the serum activity of enzymes involved in energy and plastic metabolic processes in order to determine changes in the metabolism and to evaluate the corrective effects of a combination of preventive steps used in a 370 day antiorthostatic hypokinesia study. The preventive measures included drugs intended to normalize water-salt, mineral and lipid metabolism, calcium metabolism and the functioning of the pancreas, plus physical exercise in the horizontal position. A reduction in creatine phosphokinase level was observed during the course of the test, as well as decreases in isocitrate and glutamate dehydrogenase and increases in alanine and aspartate aminostransferase, gamma glutamyltransferase and lactate dehydrogenase, all of which returned to the normal levels during the recovery period following the hypokinesia. The preventive measures decreased the drop in creatine phosphokinase, gamma glutamyltransferase and aspartate aminotransferase. Author

N91-30676# Joint Publications Research Service, Arlington, VA.
OCULAR-VESTIBULAR-MOTOR INTERACTIONS IN EXPERIMENTAL LABYRINTH ASYMMETRY Abstract Only
A. A. Repin *In its* JPRS Report: Science and Technology. USSR: Life Sciences 25 Oct. 1990 p 2 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 23, no. 4, Jul.-Aug. 1989 p 59-64 (For primary document see N91-30670 22-52)
Avail: NTIS HC/MF A04

The vestibular apparatus has a particular role in the coordination of movements of the eyes and head for gaze fixation. Stimulation of the labyrinth by electric current can imitate changes in the vestibular function observed immediately after labyrinthectomy and, in combination with immersion hypokinesia, can stimulate changes characteristic for the acute period of adaptation to weightlessness. The changes are compared in coordination of eye and head movements during trigger and predictive gaze fixation under conditions of experimental labyrinth asymmetry achieved by electrical stimulation. Alteration in the control of head and eye movement were followed by short term oscillopsia as a result of changes in the gain coefficient of the 'ocular vestibular motor' system. Unilateral stimulus of the labyrinths thus caused disorders in the coordination of head and eye movements with both trigger and predictive gaze fixation, reflecting processes of alteration of the excitability of the labyrinths. The altered status of the afferent element of the vestibular apparatus is manifested as disorders in coordination of the motor systems, deterioration, and instability of gaze fixation.
Author

N91-30677# Joint Publications Research Service, Arlington, VA.
DIFFERENTIAL CRITERION FOR TOLERANCE OF A BLOW TO THE HEAD IN CERTIFICATION OF PROTECTIVE GEAR Abstract Only
A. S. Barer, Yu. G. Konakhevich, L. N. Sholpo, D. A. Kurme, and L. Ya. Leytene *In its* JPRS Report: Science and Technology. USSR: Life Sciences 25 Oct. 1990 p 2-3 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 23, no. 4, Jul.-Aug. 1989 p 76-79 (For primary document see N91-30670 22-52)
Avail: NTIS HC/MF A04

A probability criterion was previously suggested for certification of pilots' headgear in which the severity of a blow to the head was evaluated in the context of flying conditions, with particular attention devoted to ensuring the pilot's ability to save himself in an emergency situation and survive for an extended period of time in an uninhabited area. A more flexible criterion was sought that takes into consideration the specific conditions of an emergency, such as the possibility of timely arrival of assistance. A differential criterion was developed in three stages: selection of clinical parameters for differential evaluation of the effects of a blow to the head; determination of the relationship of clinical signs of head trauma to impact parameters and location; and selection of critical parameters of impact trauma for differential evaluation of protective headgear and their certification. The results of the analysis were used to construct regression equations for the probability of various levels of trauma protection as functions of the maximum contact force.
Author

N91-30678# Joint Publications Research Service, Arlington, VA.
PREDICTING THE EFFECT OF LINEAR AND ANGULAR IMPACT ACCELERATION ON HUMANS Abstract Only
Yu. V. Mazurin and G. P. Stupakov *In its* JPRS Report: Science and Technology. USSR: Life Sciences 25 Oct. 1990 p 3 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 23, no. 4, Jul.-Aug. 1989 p 79-83 (For primary document see N91-30670 22-52)
Avail: NTIS HC/MF A04

Modern methods of optimizing man-machine system interactions require planning of the actions of the operator not only under ordinary conditions of operation of aircraft, but also under extreme conditions and emergency situations in which the operator may be exposed to high levels of linear and angular acceleration. A method is described for computer prediction of the probability of injury to individual subsystems of the body, as well as changes in activity, physiological responses, and subjective estimates of tolerance. The method is a combination of traditional methods of estimating the danger of injury in impact acceleration, and it is based on determination of statistical relationships between biomechanical and other effects described in a mathematical model of the human body. A flow chart of the algorithm used is presented. The method enables expansion of the list of predicted effects and evaluation of the tolerance of complex actions. It decreases the demands for the degree of identification of parameters of the mathematical model and increases the flexibility of simulations, allowing modern methods to be used for the accumulation and statistical processing of biomedical information.
Author

N91-30679# Virginia Mason Research Center, Seattle, WA.
INFLUENCE OF ANTICHOLINESTERASE ON DISTRIBUTION OF VENTILATION AND GAS EXCHANGE Final Report, Jan. - Nov. 1985
Harold I. Modell Oct. 1990 15 p

(Contract F33615-85-C-4512)
(AD-A229341; USAFSAM-TR-90-30) Avail: NTIS HC/MF A03 CSCL 06/11

This project was designed to titrate the influence of pyridostigmine on pulmonary resistance and gas exchange. Experiments in pigs and dogs indicate that significant alterations in pulmonary function do not occur until acute dosages in the range of 3 to 6 mg/kg are reached. Furthermore, acute administration of large doses of pyridostigmine results in salivation and gastrointestinal stimulation well in advance of any impairment to respiratory function. GRA

N91-30680# Colorado Univ., Denver. Health Sciences Center.
SLEEP DISTURBANCES AT HIGH ALTITUDE. ROLE OF A PCO2 APNEIC THRESHOLD Final Report, 14 Jun. 1985 - 15 Jun. 1987
John T. Reeves and John V. Weil 9 Jun. 1990 13 p
(Contract DAMD17-85-C-5205; DA Proj. 3E6-2777-A-879)
(AD-A229426) Avail: NTIS HC/MF A03 CSCL 06/5

This study addressed the issue as to how exposure and subsequent acclimatization to high altitude influences ventilatory control during wakefulness and sleep and considers the potential implications of such changes for adjustment to high altitude. Specifically, it has been known for some time that during several days exposure to high altitude there occurs a steady, progressive rise in ventilation, the origins of which have been the subject of extensive controversy. Under these same conditions, it is also known that sleep disturbance associated with periodic breathing is common. To further investigate these issues, we studied six healthy males at sea level an on nights 1, 4, and 7, after arrival at high altitude (14,110 feet). During wakefulness, ventilation and the ventilatory responses to hypoxia and hypercapnia were measured, and during both non-rapid-eye-movement and rapid-eye-movement sleep, ventilation, ventilatory pattern and hypercapnic ventilatory response were measured. GRA

N91-30681# Florida Univ., Saint Augustine. Lab. for Experimental Marine Biology and Medicine.
INHIBITION OF OLFACTORY RECEPTOR CELLS: AN AQUATIC MODEL Annual Report, Mar. 1990 - Mar. 1991
Barry W. Ache Apr. 1991 44 p
(Contract N00014-90-J-1566; NR Proj. RR0-4108)
(AD-A234437) Avail: NTIS HC/MF A03 CSCL 06/3

The receptor cell is the first level of olfactory integration in some, and possibly all, organisms. Experimental and modeling analyses of lobster olfaction assign the integrative properties of the receptor cell to the expression of multiple, opposing transduction pathways, as well as to the passive electrical properties of the cell. GRA

N91-30682# Scotgen Ltd., Aberdeen (Scotland).
RESHAPED HUMAN MONOCLONAL ANTIBODIES FOR THERAPY AND PASSIVE IMMUNIZATION Midterm Report, 31 Jul. 1989 - 30 Jul. 1990
William J. Harris 20 Aug. 1990 37 p
(Contract DAMD17-89-C-9060; DA Proj. 3M1-61102-BS-12)
(AD-A234770) Avail: NTIS HC/MF A03 CSCL 06/5

The purpose of the project is to apply reshaping technology for the humanisation of monoclonal antibodies specific for junin and vaccinia viruses. The cloning of immunoglobulin variable region heavy (VH) and light (VK) chain genes was achieved through synthesis and amplification of complementary DNA (cDNA) copied from RNA extracted from mouse hybridoma cells. For anti-junin, comprehensive VH and VK sequences were obtained, the CDR (complementarity determining regions) sequences elucidated, and the CDR's transplanted onto human VH and VK genes. Human IgGl and Kappa constant regions were then added to produce humanised anti-junin immunoglobulin genes which are currently being introduced into mammalian cells for humanized antibody production. For anti-vaccinia, comprehensive sequencing of VH and VK genes is in progress and partial VH sequence is reported. GRA

N91-30683# Joint Publications Research Service, Arlington, VA.
JPRS REPORT: SCIENCE AND TECHNOLOGY. USSR: LIFE SCIENCES
19 Feb. 1991 65 p Transl. into ENGLISH from various Russian articles
(JPRS-ULS-91-005) Avail: NTIS HC/MF A04

Several topics related to U.S.S.R. science and technology are covered. Topics include aerospace medicine, agricultural science, biochemistry, biophysics, biotechnology, epidemiology, genetics, human factors engineering, immunology, laser bioeffects, clinical medicine, public health, psychology, radiation biology, veterinary medicine, and virology. For individual titles, see N91-30684 through N91-30689.

N91-30684# Joint Publications Research Service, Arlington, VA.
POSSIBILITIES OF USING FLIGHT SIMULATORS IN DYNAMIC MEDICAL OBSERVATION OF FLIGHT CREW Abstract Only **c09**
V. A. Bodrov *In its* JPRS Report: Science and Technology. USSR: Life Sciences 19 Feb. 1991 p 1 Transl. into ENGLISH from Voyenno-Meditsinskiy Zhurnal, Moscow (USSR), no. 11, Nov. 1989 p 51-55 (For primary document see N91-30683 22-52)
Avail: NTIS HC/MF A04

Practical recommendations obtained from experimental studies on pilots with functional diseases of the nervous system and cardiovascular system are suggested to further expand the occupational skills of the flight physician, who can use the psychophysiological data not only when assessing flight readiness, but also in treatment and prevention work with a flight crew. A number of psychophysiological mechanisms were isolated that are important from the standpoint of the regulation of flight activity and resistance to stress factors. Disruption of those mechanisms in functional disorders can be identified through the use of the flight simulator. It is recommended that the occupational stress tests be used on the simulator for early diagnosis of functional disorders associated with the occupational problems of pilots, for evaluation of the occupational fitness and psychophysiological reactions of pilots with functional diseases, and for analysis of the possible connection of poor pilot performance in flight and an individual's psychological traits. The results of occupational stress tests can be used to plan measures for increasing combat effectiveness and flight safety while maintaining the occupational health of the flight crew. Author

N91-30685# Joint Publications Research Service, Arlington, VA.
FEEDING THE SALYUT-7 CREWS Abstract Only **c54**
V. P. Bychkov, S. Kalandarov, A. N. Agureyev, I. G. Popov, A. N. Kochetkova, and A. S. Ushakov *In its* JPRS Report: Science and Technology. USSR: Life Sciences 19 Feb. 1991 p 1 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 23, no. 4, Jul.-Aug. 1989 p 9-14 (For primary document see N91-30683 22-52)
Avail: NTIS HC/MF A04

The food products developed for the Salyut-7 crews consists primarily of dehydrated products to be rehydrated with hot or cold water before consumption. They are served in four meals a day on a six-day menu. The daily ration contains approximately 130 g protein, 120 g fat, 360 g carbohydrates, for a total of 3000 calories. The crews take multivitamins twice a day. Discussed here are some of the results of a physiological-hygienic evaluation of the food rations supplied to the crews of five long-duration Salyut-7 missions ranging from 126 days to 211 days in length. Analysis of a 68-day preflight test of the rations and of the five missions aboard the Salyut-7 indicated that all components of the food operations functioned as intended and were generally well thought of by the cosmonauts. The daily diet kept the cosmonauts strong enough to perform their jobs. Author

N91-30686# Joint Publications Research Service, Arlington, VA.
REACTION OF SYMPATHOADRENAL SYSTEM OF COSMONAUTS AFTER LONG MISSIONS ON SALYUT-7 ORBITAL SPACECRAFT Abstract Only

N. A. Davydova, R. Kvetnyanski, and A. S. Ushakov *In its* JPRS Report: Science and Technology. USSR: Life Sciences 19 Feb. 1991 p 1 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 23, no. 4, Jul.-Aug. 1989 p 14-20 (For primary document see N91-30683 22-52)
Avail: NTIS HC/MF A04

Because the sympathoadrenal system is an important component of neurohumoral regulation, study of its hormonal and mediator components is particularly important for long-duration space flights, when the body is exposed to extreme conditions and the ability to adapt to such conditions determines, to a large extent, the success and completion of the mission. Here, a broad spectrum of sympathoadrenal activity indicators is utilized to study catecholamine metabolism in cosmonauts after missions of 211 and 237 days, as well as during the missions. Immediately after the shorter flight, adrenaline, 4-hydroxy 3-methoxymandelic acid, and homovanillic acid levels were higher than preflight levels; noradrenaline, dopamine, DOPA, methanephrine, and normethanephrine levels were lower than pre-flight levels. Excretion of catecholamines, DOPA, and metabolites gradually rose and, by post-flight days 3-6, were considerably higher than preflight levels. None of the indicators normalized until 45 days after the flight. Analysis of the sympathoadrenal activity showed the hormonal component to have been stimulated, with the adrenaline/noradrenaline ratio twice as high as the pre-flight ratio. The transmitter component activity was inhibited such that the nonadrenaline synthesis was low on the day of the landing, after which it gradually rose. Dopamine synthesis behaved in an opposite manner. Blood catecholamines increased slightly on days 217-219 of the 237-day flight, while their content in the urine remained constant and the excretion of metabolites decreased, all parameters increasing significantly following the flight. Author

N91-30687# Joint Publications Research Service, Arlington, VA.
DIFFERENTIAL CRITERION FOR TOLERANCE OF A BLOW TO THE HEAD IN CERTIFICATION OF PROTECTIVE GEAR Abstract Only **c54**
A. S. Barer, Yu. G. Konakhevich, L. N. Sholpo, D. A. Kurme, and L. Ya. Leytene *In its* JPRS Report: Science and Technology. USSR: Life Sciences 19 Feb. 1991 p 3 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 23, no. 4, Jul.-Aug. 1989 p 76-79 (For primary document see N91-30683 22-52)
Avail: NTIS HC/MF A04

A probability criterion was previously suggested for certification of pilots' headgear in which the severity of a blow to the head was evaluated in the context of flying conditions, with particular attention devoted to ensuring the pilot's ability to save himself in an emergency situation and survive for an extended period of time in an uninhabited area. The authors sought a more flexible criterion that takes into consideration the specific conditions of an emergency, such as the possibility of the timely arrival of assistance. A differential equation was developed in three stages: selection of clinical parameters for differential evaluation of the effects of a blow to the head; determination of the relationship of clinical signs of head trauma to impact parameters and location; selection of critical parameters of impact trauma for differential evaluation of protective headgear and their certification. The results of the analysis were used to construct regression equations for the probability of various levels of trauma protection as functions of maximum contact force. Author

N91-30688# Joint Publications Research Service, Arlington, VA.
PREDICTING THE EFFECT OF LINEAR AND ANGULAR IMPACT ACCELERATION ON HUMANS Abstract Only
Yu. V. Mazurin and G. P. Stupakov *In its* JPRS Report: Science and Technology. USSR: Life Sciences 19 Feb. 1991 p 3 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 23, no. 4, Jul.-Aug. 1989 p 79-83 (For primary document see N91-30683 22-52)
Avail: NTIS HC/MF A04

Modern methods of optimizing man-machine system interactions require planning of the actions of the operator, not only under ordinary conditions of operation of an aircraft, but also under extreme conditions and emergency situations in which the operator may be exposed to high levels of linear and angular acceleration. Described here is a method for computer prediction of the probability of injury to individual subsystems of the body, as well as changes in activity, physiological responses, and subjective estimates of tolerance. The method is a combination of traditional methods of estimating the danger of injury in impact acceleration, and it is based on the determination of statistical relationships between biomechanical and other effects described in a mathematical model of the human body. A flow chart of the algorithm employed is presented. The method enables the expansion of the list of predicted effects and evaluation of the tolerance of complex actions. It decreases the demands for the degree of identification of parameters of the mathematical model and increases the flexibility of simulations, allowing modern methods to be used for the accumulation and statistical processing of biomedical information and mathematical modeling to assure safety and continued efficiency of aircraft crews. Author

N91-30689# Joint Publications Research Service, Arlington, VA.
ANALYSIS OF METHODS OF PRESENTING INFORMATION TO AN OPERATOR IN THE CONTROL PROCESS Abstract Only **c06**
Yu. P. Yablonko and V. F. Anishchenko *In its* JPRS Report: Science and Technology. USSR: Life Sciences 19 Feb. 1991 p 3-4 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 23, no. 4, Jul.-Aug. 1989 p 83-85 (For primary document see N91-30683 22-52)
Avail: NTIS HC/MF A04

In the sensomotor-based control systems widely used in aircraft and spacecraft, it is very important that the choice of information models for determination of the effectiveness criterion of operators' actions be sound. Discussed here is a system for controlling a dynamic object. The system includes the object of the control, digital and analog parameter indicators, and a manual control device. For the operator, the study objective is to move the object of control from one state to another. Two methods of display of controlled parameters are used: a cathode ray tube illustrating the status of the controlled object by the position of a symbol on the screen, and digital indicators reflecting the values of state criteria. An information approach to analysis of the control process examines the change in entropy of the object of control. The rate of change is characterized by the information flow acting on the operator during the performance of the control tasks with various display devices. The approach enables quantitative estimation of the information load on the operator, and the information flow can be used as a characteristic of the operator's throughput capacity. The distribution of information flow depends on the method by which the information is presented. When working with an analog indicator, an operator can perceive a greater quantity of information per unit time than when a digital indicator is used. Author

N91-30690# Medical Coll. of Georgia, Augusta. Shock Society.
A REVIEW: THE 13TH ANNUAL CONFERENCE ON SHOCK Final Report, 3 Mar. - 14 Sep. 1990
Sherwood M. Reichard 1 Jun. 1991 7 p Conference held in Durango, CO, 8-11 Jun. 1990
(Contract DAMD17-90-Z-0028)
(AD-A237300) Avail: NTIS HC/MF A02 CSCL 06/5

The Shock Society presented the Thirteenth Annual Conference on Shock during June 8 to 11, 1990, in Durango, Colorado. The meeting was attended by about 400 clinical and basic scientists representing numerous biomedical disciplines and clinical specialty areas: a common denominator was a shared major interest in some aspects of shock and trauma research. The scientific program comprised over 200 presentations constituting three major symposia, three minisymposia, 4 young investigators competition, three workshops, and eleven thematic poster sessions. Emphasis

was placed on currently emerging concepts concerning the pathogenesis and management circulatory shock, sepsis, trauma, ischemia, inflammation, and their multifaceted interactions. The majestic southern Rocky Mountains were nearby for viewing and excursion. these observations indicate that the scientific presentations, attendance, audience discussions-debates, and venue for the Thirteenth Annual Conference on Shock were of exceptional quality and successfully continued the long-standing tradition of scientific excellence promulgated by the Shock Society. GRA

N91-30691# National Oceanic and Atmospheric Administration, Boulder, CO. Wave Propagation Lab.
IRRADIANCE DISTRIBUTIONS ON THE HUMAN RETINA FROM A LASER OBSERVED THROUGH THE TURBULENT ATMOSPHERE
J. H. Churnside and R. J. Hill Apr. 1991 80 p
(PB91-196907; NOAA-TM-ERL-WPL-196) Avail: NTIS HC/MF A05 CSCL 06R

The statistics of position and size of the focal spot on a simulated human retina for laser illumination through refractive turbulence in the atmosphere were measured. Both 3 and 7 mm apertures were used under a variety of propagation conditions. No significant mitigating effects of spot broadening or motion were observed. Author

N91-30692*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
DOPPLER INDICES OF GAS PHASE FORMATION IN HYPOBARIC ENVIRONMENTS: TIME-INTENSITY ANALYSIS
Michael R. Powell Sep. 1991 61 p
(NASA-TM-102176; S-626; NAS 1.15:102176) Avail: NTIS HC/MF A04 CSCL 06P

A semi-quantitative method to analyze decompression data is described. It possesses the advantage that it allows a graded response to decompression rather than the dichotomous response generally employed. A generalized critical volume (C-V), or stoichiometric time-dependent equilibrium model is examined that relates the constant of the equation P sub i equals m P sub f plus b to variable tissue supersaturation and gas washout terms. The effects of the tissue ratio on gas phase formation indicate that a decreased ratio yields fewer individuals with Doppler detectable gas bubbles, but those individuals still present with Spencer Grade 3 or 4. This might indicate a local collapse of tissue saturation. The individuals with Grade 3 or 4 could be at risk for type 2 decompression sickness by transpulmonic arterialization. The primary regulator of the problems of decompression sickness is the reduction of local supersaturation, presumably governed by the presence and number of gas micronuclei. It is postulated that a reduction in these nuclei will favor a low incidence of decompression sickness in microgravity secondary to hypokinesia and adynamia. Author

N91-30693 Institute for Perception RVO-TNO, Soesterberg (Netherlands). Audiology Group.
DAMAGE RISK FOR LOW-FREQUENCY IMPULSE NOISE; THE SPECTRAL FACTOR IN NOISE-INDUCED HEARING LOSS Final Report
G. F. Smoorenburg 14 Nov. 1990 29 p
(Contract A86/M/161)
(IZF-1990-A-37; TD-90-3413; ETN-91-99820) Copyright Avail: Institute for Perception RVO-TNO, P.O. Box 23, 3769 SG Soesterberg, Netherlands

The prediction of risk of hearing damage for impulse noise is commonly based on either the peak level of the impulses, their duration and the total number of impulses or on the total energy contained in the impulse noise exposure. These physical measures do not include frequency dependent weighting of the impulse energy whereas such weighting (A weighting) is applied when dealing with steady state noise. The results of animal experiments suggest that, at equal peak level, risk of hearing damage is not higher for large caliber weapons than for light caliber weapons, although impulse duration for large caliber weapons assumes about tenfold the light caliber value. The results suggest that low frequency energy in the impulse is less damaging to the ear than mid and high frequency energy. All human data on temporary threshold shifts after exposure to large caliber weapons are examined against the existing criteria based primarily on light caliber weapons, excluding and including frequency dependent A weighting. The results suggest the inclusion of a weighting into damage risk criteria for impulse noise. ESA

N91-30694# Royal Signals and Radar Establishment, Malvern (England).
INFORMATION PROCESSING IN THE OUTER RETINA
S. Collins 18 Apr. 1991 21 p
(RSRE-Memo-4469; BR302008; ETN-91-99848) Copyright Avail: NTIS HC/MF A03

Analog electronics appears to offer the most direct way to mimic the information processing which occurs in the dendrites of neurons. Unfortunately, analog electronics suffers from a restricted dynamic range, a problem which also occurs in neurons. This study was initiated to understand how biological neural systems overcome the problems inherent in employing components with an adequate dynamic range. The inadequacy of the dynamic range available in neurons is most apparent in retinas which deal with an input signal covering five decades using components with a dynamic range of less than two decades. The predictive encoding hypothesis which is proposed to explain the function of the outer retina is adopted as a framework for understanding the neurological data discussed. Then, three different, independently evolved, retinas are considered to demonstrate the different implementations of the same underlying principle. It is shown that the problems posed by the limited dynamic range available in both neurons and analog electronics can be overcome if the system is correctly designed. ESA

N91-30695# Amsterdam Univ. (Netherlands). Dept. of Mathematics and Computer Science.
PHYSIOLOGICAL MODELLING USING RL
Fred deGeus, Ernest Rotterdam (Groningen Rijksuniv., Neverlands), Sieger vanDenneheuvel, and Peter vanEmdeBoas Dec. 1990 17 p
(ITLI-CT-90-08; ISSN-0924-8374; ETN-91-99569) Avail: NTIS HC/MF A03

The use of constraints to build quantitative physiological models and the application of these models to assist anaesthetists in decision making are discussed. A simple physiological model of human blood circulation and gas is given. It is represented in RL (Relational Language) and used for interpretation and prediction purposes. Interaction with the anaesthetist is required about intermediate results and further assumptions to be made. As time in the operating theater is limited, an optimal interface is essential. Effective interaction must be possible however, because making assumptions is the way in which physicians cope with incompleteness of information. A constraint solver provides a tool to support this. ESA

53 BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

N91-30696# Massachusetts Inst. of Tech., Cambridge. Dept. of Brain and Cognitive Sciences.
REPRESENTATIONS IN MENTAL MODELS Final Technical Report
Whitman Richards Sep. 1990 34 p
(Grant AF-AFOSR-0177-90)
(AD-A229401; AFOSR-90-1127TR) Avail: NTIS HC/MF A03 CSCL 05/8

On March 12 to 13 an interdisciplinary group of thirty-five, composed of computer scientists, experimental psychologists, linguists, philosophers and connectionists met to share views on

representations and their role in mental models. Although at least two books and several papers directly address these issues, the nature of mental models is far from clear. The meeting shed some light on why understanding mental models is difficult. Simply put, the reason is that mental processes are described in many different ways and at quite different levels of abstraction, depending upon the researcher. For example, some emphasize the cognitive properties of mental models, whereas others are more concerned with the internal data structures. Still others may stress the logical form and content of the mental process, as contrasted with the actual computational machinery. The diversity of these viewpoints is clear upon reading the abstracts prepared by the participants. Further study is needed to examine how these diverse viewpoints fit together into a useful, integrated framework. GRA

N91-30697*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
THREE-DIMENSIONAL VIRTUAL ACOUSTIC DISPLAYS
Elizabeth M. Wenzel Jul. 1991 36 p
(NASA-TM-103835; A-91061; NAS 1.15:103835) Avail: NTIS HC/MF A03 CSCL 05C

The development of an alternative medium for displaying information in complex human-machine interfaces is described. The 3-D virtual acoustic display is a means for accurately transferring information to a human operator using the auditory modality; it combines directional and semantic characteristics to form naturalistic representations of dynamic objects and events in remotely sensed or simulated environments. Although the technology can stand alone, it is envisioned as a component of a larger multisensory environment and will no doubt find its greatest utility in that context. The general philosophy in the design of the display has been that the development of advanced computer interfaces should be driven first by an understanding of human perceptual requirements, and later by technological capabilities or constraints. In expanding on this view, current and potential uses are addressed of virtual acoustic displays, such displays are characterized, and recent approaches to their implementation and application are reviewed, the research project at NASA-Ames is described in detail, and finally some critical research issues for the future are outlined. Author

N91-30698 Institute for Perception RVO-TNO, Soesterberg (Netherlands). Audiology/Visuology Group.
SPATIOTEMPORAL EDGE PERCEPTION Final Report
J. T. Marcus and A. Toet 25 Oct. 1990 40 p
(IZF-1990-B-15; TD-90-3405; ETN-91-99824) Copyright Avail: Institute for Perception RVO-TNO, P.O. Box 23, 3769 ZG Soesterberg, Netherlands

The edges of straight bars in a square wave luminance grating appear to undulate to an observer when the retinal image of this pattern is in motion. The amplitude of the perceived undulations increases linearly with retinal image speed with n average slope of 30 plus or minus 4 ms. The period of the motion induced bulges is 2.5 plus or minus 0.5 degrees and shows no consistent variation with the retinal image velocity of the pattern. There is a close quantitative agreement between the spatiotemporal extent of this effect and recent estimates of the spatiotemporal parameters of human motion-sensitive mechanisms. As a tentative explanation for these observations, it is hypothesized that a moving luminance edge is encoded on a sparse neural sampling grid of motion sensitive cells in the central nervous system. These cells have a fixed time constant but change their shape and size with retinal image velocity. ESA

N91-30699 Institute for Perception RVO-TNO, Soesterberg (Netherlands). Cognitive Psychology Group.
HUMAN COGNITIVE PROCESSES IN COMMAND AND CONTROL PLANNING. 1: IDENTIFICATION OF RESEARCH ISSUES Final Report
C. A. McCann (Defence and Civil Inst. of Environmental Medicine, North York, Ontario) 28 Dec. 1990 48 p
(IZF-1990-B-18; TD-90-3423; ETN-91-99826) Copyright Avail: Institute for Perception RVO-TNO, P.O. Box 23, 3769 ZG Soesterberg, Netherlands

The activity of planning is an important component of command and control but the cognitive processes associated with human planning are not yet understood. Research that has been done on planning to determine the concepts and theory concerning human cognitive processes in planning that might be extended into the context of the command and control domain is reviewed. A particular focus is the role of computer assistance in planning. Several major factors that influence planning and that would need to be controlled in experiments studying command and control planning are identified. Important issues that should be addressed in research on command and control planning are identified. ESA

N91-30700# Technische Univ., Eindhoven (Netherlands). Faculty of Electrical Engineering.
PRELIMINARY INVESTIGATIONS OF TACTILE PERCEPTION OF GRAPHICAL PATTERNS
X. Wang (Institute for Perception RVO-TNO, Soesterberg, Netherlands) Apr. 1990 28 p
(EUT-90-E-239; ISBN-90-6144-239-7; ISSN-0167-9708; ETN-91-99619) Avail: NTIS HC/MF A03

Investigations on tactile perception of graphical patterns are presented. The tactile patterns used in the two experiments were generated on an Optacon vibrating array, with a modified system. The setup built for these experiments is described. The design of the experimental paradigms with the aim of solving a problem in the related literature is discussed. Preliminary results from the experiments show an agreement with the literature, even though the data were obtained from a different paradigm. ESA

N91-30701# Technische Univ., Eindhoven (Netherlands). Faculty of Electrical Engineering.
A MEMBRANE MODEL FOR SPATIOTEMPORAL COUPLING
A. C. denBrinker Jun. 1990 27 p
(EUT-90-E-241; ISBN-90-6144-241-9; ISSN-0167-9708; ETN-91-99621) Avail: NTIS HC/MF A03

A model for spatiotemporal coupling within the transient visual system is proposed. The main features of the model are linearity, rotation symmetry, and parsimonious use of parameters. The spatial transfer function of the model has a low pass character with a cut off frequency that depends on the temporal frequency. For the transient system the model can be completetly parametrized using subthreshold measurements of impulse responses. The model is in agreement with physiological data on lateral information spread within the retina. The model was tested for predictions on flashed and sinusoidal stimuli and agrees in all major aspects with the experimental data. ESA

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

For related information see also *16 Space Transportation.*

N91-30702# Analysis and Technology, Inc., New London, CT.
EVALUATION OF NIGHT VISION GOGGLES FOR MARITIME SEARCH AND RESCUE. VOLUME 2: DATA APPENDIX Interim Report
W. H. Reynolds, R. Q. Robe, G. L. Hover, and J. V. Plourde Apr. 1990 87 p
(Contract DTCG39-89-C-80671)
(AD-A229393; USCG-D-14-90-Vol-2) Avail: NTIS HC/MF A05 CSCL 20/6

Three experiments were conducted during 1989 by the U.S. Coast Guard Research and Development (R and D) Center to evaluate night vision goggles (NVGs) for their effectiveness in detecting small targets at night. Three types of NVGs were evaluated: the AN/AVS-6 Aviators Night Vision Imaging System

(ANVIS) NVG was tested onboard Coast Guard HH-3 and Ch-3 helicopters, and the AN/PVS-5C and AN/PVS-7A NVGs were tested onboard 41-foot Coast Guard utility boats (STBs). Simulated persons in the water (PIWs), 4- and 6-person life rafts, 18- and 21-foot white boats, and white, personal flotation device (PFD) strobe lights were employed as targets during realistically-simulated search missions. A total of 1,490 target detection opportunities were generated during the experiments. These data were analyzed to determine which of 25 search parameters of interest exerted a statistically-significant influence on target detection probability.
GRA

N91-30703# Anacapa Sciences, Inc., Fort Rucker, AL.
TASK ANALYSIS AND WORKLOAD PREDICTION MODEL OF THE MH-60K MISSION AND A COMPARISON WITH UH-60A WORKLOAD PREDICTIONS. VOLUME 3: APPENDIXES H THROUGH N Interim Report, Dec. 1988 - Apr. 1990
Carl R. Bierbaum and David B. Hamilton Oct. 1990 259 p
(Contract MDA903-87-C-0523)
(AD-A229408; ASI690-328-90-III-Vol-3; ARI-RN-91-02-Vol-3)
Avail: NTIS HC/MF A12 CSCL 05/8

For this research, a mission scenario was used to conduct a comprehensive task analysis for MH-60K operations. The analysis used a top-down approach to identify 5 phases, 15 segments, 71 functions, and 230 tasks for the mission. Also, the crewmember performing each task was identified, and estimates of the task durations and the sensory, cognitive, and psychomotor workload associated with the tasks were derived. The mission/task/workload analysis data were used to develop a computer model of workload for MH-60K crewmembers. The model used a bottom-up approach to build mission functions from tasks and mission segments from functions. Decision rules were written to specify the procedure for combining tasks into functions and functions into segments. The model permitted an analysis of total workload experienced by the pilot and copilot in the performance of both sequential and concurrent tasks. The predicted workload for the MH-60K pilot and copilot was compared to the UH-60A baseline workload prediction to determine the impact of the MH-60K advanced technology. The comparison indicated very little difference in the predicted workload for the pilot and lower predicted workload for the copilot in the MH-60K.
GRA

N91-30704 McMaster Univ., Hamilton (Ontario). Dept. of Physical Education and Dept. of Medicine.
EVALUATION OF ALTERNATIVE METHODS FOR INCREASING TOLERANCE TO +Gz ACCELERATION, PHASE 2 Final Report
J. D. MacDougall Dec. 1989 26 p
(Contract DCIEM-W7711-8-7042/01-SE)
(CTN-91-60128) Avail: NTIS HC A03

Unconsciousness can occur during exposure to sustained, headward radial acceleration (G) due to hypotension at head level; thus, methods of improving G tolerance of pilots of high performance aircraft are required. The aim of these experiments at 1 G was to determine an alternate protocol for forceful leg contractions that could assist the standard anti-G straining maneuver to increase blood pressure. Using an exercise of hip and knee extension in the sitting position, it was found that: (1) isometric, muscular contractions were more effective at increasing mean arterial blood pressure than concentric or eccentric contractions; (2) the relative intensity of the isometric contraction determined the magnitude of the blood pressure increase throughout a knee joint angle range of 75 to 105 deg; (3) simultaneous, double leg contractions produced greater blood pressure increases than alternating, single leg contractions; (4) a continuous 30 sec isometric contraction was superior to repeated 5 sec contractions followed by either 5 or 2 sec relaxation periods; and (5) the increase in blood pressure was independent of individual differences in absolute quadriceps muscle strength and/or muscle cross-sectional area, and was directly related to the relative intensity of contraction effort.
Author (CISTI)

N91-30705 Biokinetics and Associates Ltd., Ottawa (Ontario).
CRITIQUE OF A PROCESS PROPOSED TO DETERMINE CF AIRCREW/COCKPIT COMPATIBILITY
James Newman, Terrance Smith, Jocelyn Pedder, and Silvana Filoso Jul. 1988 44 p Sponsored by Defence and Civil Inst. of Environmental Medicine
(DCIEM-R88-7C; CTN-91-60208) Avail: NTIS HC A03

A critique is provided of the aircrew cockpit compatibility evaluation process proposed for use in the review of the Canadian Forces (CF) aircrew selection standards. This process would use a computer man-modelling package known as System for Aiding Man/Machine Interaction Evaluation (SAMMIE). In the critique, discussion has been limited to issues of vision, reach, and clearance. The main points of the critique are as follows: (1) The generation of 2-D criterion envelopes is based on the assumption that each criterion depends on only two parameters. This might not always be true. The validity of the criterion envelope should be tested with the model before it is assumed to be true. (2) The proposed process considers only limiting cases of crew station geometry. This may lead to errors in interpretation when attempting to establish workstation limitations since critical geometries may occur at intermediate configurations. (3) The unlimited manipulation of anthropometric parameters provided by the system is unnecessary. Manipulation of parameters outside human limits would consume a considerable amount of processing time. (4) Specific limitations inherent to the SAMMIE model and workstation data may defeat the purpose of the proposed process and limit its generality.
CISTI

N91-30706 Defence and Civil Inst. of Environmental Medicine, Downsview (Ontario).
CANADIAN FORCES FLIGHT TRIAL OF INDIVIDUALLY MOLDED FIBERGLASS LUMBAR SUPPORTS
J. R. Popplow and L. L. M. Bossi Mar. 1988 35 p
(DCIEM-88-RR-12; CTN-91-60212) Avail: NTIS HC A03

Individually molded fibreglass lumbar supports may be useful in alleviating backache in aircrew members. This paper concludes a flying trial of 13 fixed wing (FW) and 25 rotary wing (RW) aircrew. Each aircrew member had been referred with a complaint of recurrent backache in their particular flying environment. Thirty-eight aircrew members were individually fitted, flew from five to 300 hours wearing the lumbar support, then completed a pre- and post-support subjective evaluation. Prior to use of the lumbar support, most subjects experienced frequent or occasional backache of varied duration. Trial participants indicated that the lumbar supports were easy to handle and position in the aircraft with only occasional shifting during flight. Most aircrew were not distracted, and all reported that flying performance was not affected while lumbar supports were worn. The two year study of lumbar support use had the following results: 60 percent of FW subjects and 32 percent of RW subjects reported fatigue relief; 75 percent of FW subjects and 36 percent of RW subjects reported considerably less backache; and 85 percent of the FW subjects and 45 percent of the RW subjects reported increased sitting comfort. It is speculated that the FW aircrew benefitted more because they were able to sit upright more consistently than RW aircrew and this upright posture allowed the lumbar support to provide its benefits.
Author (CISTI)

N91-30707 McMaster Univ., Hamilton (Ontario). Dept. of Physical Education.
EVALUATION OF ALTERNATIVE METHODS FOR INCREASING TOLERANCE TO +Gz. A PRELIMINARY STUDY OF DYNAMIC LEG EXERCISE Final Report
J. D. MacDougall Mar. 1988 44 p
(Contract DCIEM-W-711-6-9281/01-SE)
(CTN-91-60213) Avail: NTIS HC A03

Traditionally, pilots exposed to high G forces have attempted to maintain brain level arterial pressure by static contractions of the abdomen and limb muscles. It has been hypothesized that forceful dynamic contractions of the lower limbs, such as a leg press maneuver, would result in greater elevations in arterial blood pressure than can be achieved by the traditional maneuvers, and

that such techniques might be a more effective means of increasing high G force tolerance than existing practices. A laboratory study to examine this hypothesis is presented. The study showed that forceful dynamic contractions resulted in considerably greater elevations in mean arterial blood pressure than the traditional maneuvers. In addition, for a given increase in blood pressure, forceful leg contractions are considerably less fatiguing. This suggests that dynamic contraction might have further advantages in situations of sustained high G accelerations. Inflation of an anti-G suit on its own has little effect on arterial pressure at high G, however it exaggerates the blood pressure response to both traditional maneuvers and the dynamic leg press response. The effectiveness of this mechanism is not related to the magnitude of the suit inflation pressure above a pressure of 90 Torr. CISTI

N91-30708 Institute for Perception RVO-TNO, Soesterberg (Netherlands). Traffic Behavior Group.
THE USE OF AN ACTIVE GAS-PEDAL AS AN ELEMENT OF AN INTELLIGENT DRIVER SUPPORT SYSTEM: LITERATURE REVIEW AND EXPLORATIVE STUDY Final Report
J. Godthelp 29 Nov. 1990 21 p
(IZF-1990-B-17; TD-90-3415; ETN-91-99825) Copyright Avail: Institute for Perception RVO-TNO, P.O. Box 23, 3769 ZG Soesterberg, Netherlands

The question whether an active gas pedal may serve as an element of an integrated information system in a car is studied. The idea behind the use of active controls is to reduce driver workload by using the controls, i.e., pedals and steering wheel, not only as control devices but as information systems to the driver. A short literature review is presented in which the effectiveness of conventional speed and headway controlling measures is discussed. The use of active controls in aerospace indicates that an active gaspedal might be an effective feedback system when using the pedal force as information carrier. For the sake of experimentation, a servocontrolled, programmable gas pedal is developed and mounted in the TNO driving simulator. An explorative experiment is carried out to demonstrate the potential effects of such a device. Subjects perform a dual tracking task with the steering wheel and the gas pedal controlling the horizontal and vertical position of a pointer which is projected on a screen in front of the simulator mockup. Different force feedback characteristics of the gas pedal serve as the main independent variable. The results show that force feedback about the tracking error may strongly improve performance. ESA

N91-30709 Institute for Perception RVO-TNO, Soesterberg (Netherlands). Cognitive Psychology Group.
AN EXPERIMENTAL COMPARISON BETWEEN DIFFERENT TYPES OF IN-CAR NAVIGATION INFORMATION Final Report
J. M. C. Schraagen 23 Jan. 1991 22 p
(IZF-1991-B-1; TD-91-0034; ETN-91-99827) Copyright Avail: Institute for Perception RVO-TNO, P.O. Box 23, 3769 ZG Soesterberg, Netherlands

An important design issue in the design of in-car navigation systems is what information to present to the driver. Guidelines for information presentation are developed based on a brief review of the literature. Three different types of navigation information are subsequently compared in a field experiment. The different navigation instructions are: arrows, instructions using road signs (e.g., Follow Utrecht), and multiple instructions presented simultaneously (e.g., Follow Utrecht, Follow Hoogland, Follow Leusden). The instructions are presented on cards. Forty two drivers, twenty one male and twenty one female, took part in the field study. Subjects followed navigation instructions on three different types of roads: highways, main roads within a city, and secondary roads in a residential area. Subjects were unfamiliar with the roads they drove on. Navigation errors, subjective workload estimates, and answers to questionnaires were recorded. The results show that subjects perform worse on all measures when following multiple instructions as compared to single instructions (arrows or road signs). Multiple instructions were found particularly unclear and unreliable on the busy main roads within cities rather than on higyways. No differences were found between arrows and single instructuions using road signs. ESA

N91-30710# Aeritalia S.p.A., Turin (Italy). Simulazione and Human Engineering.
HUMAN ENGINEERING ACTIVITY FOR THE DEFINITION OF VISUAL AVIONIC SYSTEMS [ATTIVITA DI HUMAN ENGINEERING PER LA DEFINIZIONE DEI SISTEMI AVIONICI DI VISUALIZZAZIONE]
Maurizio Spinoni 1991 24 p In ITALIAN
(ETN-91-99510) Avail: NTIS HC/MF A03

Basic principles of man machine interactions in visual interface systems and activities pursued for their design are presented. Such methods, for example head up display, multifunction display, and control and helmet mounted display will be integrated to give the crew a complete situation awareness for higher performance. ESA

N91-30711# Cranfield Inst. of Tech., Bedford (England). Applied Psychology Unit.
PREVENTING DRIVER ERROR AND MOTORCYCLE ACCIDENT CAUSATION: AN EMPIRICAL INVESTIGATION
Peter Brooks Mar. 1991 64 p Sponsored in part by Economic and Social Research Council
(Cranfield-Aero-9106; ISBN-1-871564-14-X; ETN-91-99543)
Avail: NTIS HC/MF A04

A framework which facilitates an understanding of driver error in interactions with Powered Two Wheelers (PTW) is presented. The concepts of technical awareness and social awareness are used to describe conditions which may predispose drivers to errors when interacting with PTW's. An empirical examination of the framework is presented, examining the relationship between lack of technical and/or social awareness and accident involvement. Relevant information was obtained from 700 drivers involved in accidents with PTW's within 9 police divisions in England. This information was compared with responses to a random survey of over 1500 drivers sampled from the same area. The results indicate that some of the most important factors in PTW accidents may be accounted for by the lack of driver technical and social awareness. It is concluded that using training and education to increase the technical and social awareness of drivers would be an area of high potential effectiveness. ESA

N91-30671# Joint Publications Research Service, Arlington, VA.
FEEDING THE SALYUT-7 CREWS Abstract Only
V. P. Bychkov, S. Kalandarov, A. N. Agureyev, I. G. Popov, A. N. Kochetkova, and A. S. Ushakov *In its* JPRS Report: Science and Technology. USSR: Life Sciences 25 Oct. 1990 p 1 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 23, no. 4, Jul.-Aug. 1989 p 9-14 (For primary document see N91-30670 22-52)
Avail: NTIS HC/MF A04

N91-30685# Joint Publications Research Service, Arlington, VA.
FEEDING THE SALYUT-7 CREWS Abstract Only
V. P. Bychkov, S. Kalandarov, A. N. Agureyev, I. G. Popov, A. N. Kochetkova, and A. S. Ushakov *In its* JPRS Report: Science and Technology. USSR: Life Sciences 19 Feb. 1991 p 1 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 23, no. 4, Jul.-Aug. 1989 p 9-14 (For primary document see N91-30683 22-52)
Avail: NTIS HC/MF A04

N91-30687# Joint Publications Research Service, Arlington, VA.
DIFFERENTIAL CRITERION FOR TOLERANCE OF A BLOW TO THE HEAD IN CERTIFICATION OF PROTECTIVE GEAR Abstract Only
A. S. Barer, Yu. G. Konakhevich, L. N. Sholpo, D. A. Kurme, and L. Ya. Leytene *In its* JPRS Report: Science and Technology. USSR: Life Sciences 19 Feb. 1991 p 3 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina,

Moscow (USSR), v. 23, no. 4, Jul.-Aug. 1989 p 76-79 (For primary document see N91-30683 22-52)
Avail: NTIS HC/MF A04

55 SPACE BIOLOGY

Includes exobiology; planetary biology; and extraterrestrial life.

No abstracts in this category.

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

N91-30712*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
A UNIQUENESS RESULT CONCERNING THE IDENTIFICATION OF A COLLECTION OF CRACKS FROM FINITELY MANY ELECTROSTATIC BOUNDARY MEASUREMENTS Final Report
Kurt Bryan and Michael Vogelius (Rutgers Univ., New Brunswick, NJ.) Jun. 1991 19 p Submitted for publication Sponsored in part by AF
(Contract NAS1-18605; NSF DMS-89-02532)
(NASA-CR-187583; NAS 1.26:187583; ICASE-91-46) Avail: NTIS HC/MF A03 CSCL 12A

The problem of locating and identifying a collection of finitely many cracks inside a planar domain from measurements of the electrostatic boundary potentials induced by specified current fluxes is considered. It is shown that a collection of n or fewer cracks can be uniquely identified by measuring the boundary potentials induced by n + 1 specified current fluxes, consisting entirely of electrode pairs. Author

N91-30713*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
MAKING INTELLIGENT SYSTEMS TEAM PLAYERS: CASE STUDIES AND DESIGN ISSUES. VOLUME 1: HUMAN-COMPUTER INTERACTION DESIGN
Jane T. Malin, Debra L. Schreckenghost, David D. Woods, Scott S. Potter, Leila Johannesen, Matthew Holloway, and Kenneth D. Forbus (Northwestern Univ., Evanston, IL.) Sep. 1991 263 p
(NASA-TM-104738; S-643; NAS 1.15:104738) Avail: NTIS HC/MF A12 CSCL 12A

Initial results are reported from a multi-year, interdisciplinary effort to provide guidance and assistance for designers of intelligent systems and their user interfaces. The objective is to achieve more effective human-computer interaction (HCI) for systems with real time fault management capabilities. Intelligent fault management systems within the NASA were evaluated for insight into the design of systems with complex HCI. Preliminary results include: (1) a description of real time fault management in aerospace domains; (2) recommendations and examples for improving intelligent systems design and user interface design; (3) identification of issues requiring further research; and (4) recommendations for a development methodology integrating HCI design into intelligent system design. Author

60 COMPUTER OPERATIONS AND HARDWARE

Includes hardware for computer graphics, firmware, and data processing.

For components see *33 Electronics and Electrical Engineering.*

N91-30714# Massachusetts Inst. of Tech., Cambridge.
CRITICAL PROBLEMS IN VERY LARGE SCALE COMPUTER SYSTEMS Semiannual Technical Report, 1 Apr. - 30 Sep. 1990
Anant Agarwal, William J. Dally, Srinivas Devadas, Thomas F. Knight, Jr., and F. T. Leighton 30 Sep. 1990 65 p
(Contract N00014-87-K-0825)
(AD-A229328) Avail: NTIS HC/MF A04 CSCL 12/7

An attempt is made to conceive of the largest possible computer for the mid to late 1990's. This machine is called an American Resource Computer or ARC. It is imagined that this machine would occupy several floors of a building. The nation could probably only afford one or two ARC's. The machine will be used to solve large scale scientific problems having both military and civilian applications. The hardware technology, software techniques, algorithms, communications, processing elements, and applications are addressed. The plausibility (not feasibility) of the machine is determined. The technical challenges of such a machine serve as the guiding stimulus for the research. Research is required to overcome the numerous hurdles to making an ARC feasible. Of the issues to be faced, the most problematic is system reliability. GRA

N91-30715# Computer Sciences Corp., Shrewsbury, NJ.
REAL-TIME REQUIREMENTS ANNEX FOR Ada REUSABILITY Final Report
25 Apr. 1990 90 p
(Contract DAAB07-85-C-K524)
(AD-A229354) Avail: NTIS HC/MF A05 CSCL 12/5

A set of guidelines for writing reusable software parts that satisfy some of the more common characteristics of real-time applications are provided. The emphasis is on coding aspects for developing reusable parts that include time dependency issues. It is structured as a stand-alone annex to a Reusability Handbook, originally developed by Computer Sciences Corporation (CSC) and enhanced by CECOM, that didn't consider any time dependency issues. The Annex contains four sections that provide a context for understanding the guidelines. The issues discussed in these sections are: distributed execution, task scheduling, error recovery, and resource control. There are five categories of guidelines included in the Annex: transportability, runtime dependency, composition orthogonality, readability, and efficiency. GRA

N91-30716# Army Aeromedical Research Lab., Fort Rucker, AL.
DEVELOPMENT OF A RUGGEDIZED HAND-HELD COMPUTER FOR PERFORMANCE TESTING IN OPERATIONAL SETTINGS Final Report
John A. Caldwell, Jr. Mar. 1990 31 p
(DA Proj. 3E1-62787-A-879)
(AD-A229421; AD-E951564; USAARL-90-8) Avail: NTIS HC/MF A03 CSCL 12/6

Portable, ruggedized computers, capable of administering standard automated tests under harsh environmental conditions, have been needed by researchers for many years. Particularly, military psychologists require tools which will permit the testing of soldiers during operationally-relevant field exercises without problems of equipment malfunctions. In 1984, the U.S. Army Research and Development Command sought to address this requirement by sponsoring a Small Business Innovative Research (SBIR) effort with Paravant Computer Systems, Inc. This SBIR resulted in the design and construction of the RHC-88, a notebook-sized, MS-DOS-based, IBM compatible computer which offers extensive programming flexibility in a portable, expandable, field-hardened unit. With the RHC-88, now it is possible to

administer a wide variety of computer-based tests in the laboratory and in the field. GRA

N91-30717# Odessey Research Associates, Ithaca, NY.
ROMULUS: A COMPUTER SECURITY PROPERTIES MODELING ENVIRONMENT OVERVIEW, VOLUME 1 Final Report, Apr. 1985 - May 1990
Ian Sutherland, Tanya Korelsky, Daryl McCullough, David Rosenthal, and Jonathan Seldin Apr. 1991 78 p
(Contract F30602-85-C-0098)
(AD-A236128; RL-TR-91-36-Vol-1) Avail: NTIS HC/MF A05 CSCL 12/8

The Romulus Report describes the Romulus Computer Security Properties Modeling Environment. Romulus is an environment and methodology for the modeling, analysis, and verification of trusted computer systems, together with supporting tools. The Romulus methodology is based on a mathematical theory of security developed at Odyssey Research Associates. The theory formalizes multilevel information flow security by introducing restrictiveness, a hookup security property. This means that a collection of secure restrictive composite system. Because of its composability, restrictiveness is a useful security property for large, complex, distributed systems. Volume 1 presents an overview of the important ideas and tools incorporated into the Romulus system. Volume 2 describes the underlying theory of security as well as Mathesis, the mathematical foundations of Romulus. GRA

N91-30718# Odessey Research Associates, Ithaca, NY.
ROMULUS: A COMPUTER SECURITY PROPERTIES MODELING ENVIRONMENT. VOLUME 2A: THE THEORY OF SECURITY Final Report, Apr. 1985 - May 1990
Ian Sutherland, Tanya Korelsky, Daryl McCullough, David Rosenthal, and Jonathan Seldin Apr. 1991 144 p
(Contract F30602-85-C-0098)
(AD-A236129; RL-TR-91-36-Vol-2A) Avail: NTIS HC/MF A07 CSCL 12/8

The Romulus Report describes the Romulus Computer Security Properties Modeling Environment. Romulus is an environment and methodology for the modeling, analysis, and verification of trusted computer systems, together with supporting tools. The Romulus methodology is based on a mathematical theory of security developed at Odyssey Research Associates. The theory formalizes multilevel information flow security by introducing restrictiveness, a hookup security property. This means that a collection of secure restrictive composite system. Because of its composability, restrictiveness is a useful security property for large, complex, distributed systems. Volume one presents an overview of the important ideas and tools incorporated into the Romulus system. Volume two describes the underlying theory of security as well as Mathesis, the mathematical foundation of Romulus. GRA

N91-30719# Odessey Research Associates, Ithaca, NY.
ROMULUS: A COMPUTER SECURITY PROPERTIES MODELING ENVIRONMENT. VOLUME 2B: MATHESIS Final Report, Apr. 1985 - May 1990
Ian Sutherland, Tanya Korelsky, Daryl McCullough, David Rosenthal, and Jonathan Seldin Apr. 1991 177 p
(Contract F30602-85-C-0098)
(AD-A236130; RL-TR-91-36-Vol-2B) Avail: NTIS HC/MF A09 CSCL 12/8

The Romulus Report describes the Romulus Computer Security Properties Modeling Environment. Romulus is an environment and methodology for the modeling, analysis, and verification of trusted computer systems, together with supporting tools. The Romulus methodology is based on a mathematical theory of security developed at Odyssey Research Associates. The theory formalizes multilevel information flow security by introducing restrictiveness, a hookup security property. This means that a collection of secure restrictive composite system. Because of its composability, restrictiveness is a useful security property for large, complex, distributed systems. Volume 1 presents an overview of the important ideas and tools incorporated into the Romulus system. Volume 2 describes the underlying theory of security as well as Mathesis, the mathematical foundation of Romulus. GRA

N91-30720*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
MINUTES OF THE CD-ROM WORKSHOP
Joseph H. King and Edwin J. Grayzeck (Interferometrics, Inc., Greenbelt, MD.) 1989 94 p Workshop held in Greenbelt, MD, 19-20 Jun. 1989
(NASA-TM-105066; NAS 1.15:105066; NSSDC-89-11) Avail: NTIS HC/MF A05 CSCL 09B

The workshop described in this document had two goals: (1) to establish guidelines for the CD-ROM as a tool to distribute datasets; and (2) to evaluate current scientific CD-ROM projects as an archive. Workshop attendees were urged to coordinate with European groups to develop CD-ROM, which is already available at low cost in the U.S., as a distribution medium for astronomical datasets. It was noted that NASA has made the CD Publisher at the National Space Science Data Center (NSSDC) available to the scientific community when the Publisher is not needed for NASA work. NSSDC's goal is to provide the Publisher's user with the hardware and software tools needed to design a user's dataset for distribution. This includes producing a master CD and copies. The prerequisite premastering process is described, as well as guidelines for CD-ROM construction. The production of discs was evaluated. CD-ROM projects, guidelines, and problems of the technology were discussed. J.P.S.

N91-30721*# Case Western Reserve Univ., Cleveland, OH. Center for Automation and Intelligent Systems Research.
ICE SYSTEM: INTERRUPTIBLE CONTROL EXPERT SYSTEM M.S. Thesis
James M. Vezina May 1990 21 p
(Grant NAG3-1010)
(NASA-CR-186966; NAS 1.26:186966; TR-90-121) Avail: NTIS HC/MF A03 CSCL 09B

The Interruptible Control Expert (ICE) System is based on an architecture designed to provide a strong foundation for real-time production rule expert systems. Three principles are adopted to guide the development of ICE. A practical delivery platform must be provided, no specialized hardware can be used to solve deficiencies in the software design. Knowledge of the environment and the rule-base is exploited to improve the performance of a delivered system. The third principle of ICE is to respond to the most critical event, at the expense of the more trivial tasks. Minimal time is spent on classifying the potential importance of environmental events with the majority of the time used for finding the responses. A feature of the system, derived from all three principles, is the lack of working memory. By using a priori information, a fixed amount of memory can be specified for the hardware platform. The absence of working memory removes the dangers of garbage collection during the continuous operation of the controller. Author

N91-30722# European Space Agency, Paris (France).
BENCHMARKING OF COMPILERS AND PROCESSORS FOR SPACE EMBEDDED REAL-TIME SYSTEMS
M. deJong, F. Gomez-Molinero (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands), and W. R. Burke, ed. Apr. 1991 103 p
(ESA-STR-233; ISBN-92-9092-160-9; ISSN-0379-4067; ETN-91-99830) Copyright Avail: NTIS HC/MF A06

The benchmarking activities carried out by ESTEC as a means of comparing several compiler/processor pairs for use in spacecraft are presented. An overview of the application area is presented. The benchmarking results are presented and discussed. Conclusions concerning the Ada compiler and processor selections are derived. Some ideas for further work are discussed. It is concluded that the performance that an application can demand from a processor depends very much on fine tuning by the programmer. ESA

N91-30723# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
LINEAR DATA STRUCTURES FOR STORAGE ALLOCATION IN ATTRIBUTE EVALUATORS
Rieks opdenAkker and Erik Sluiman 1991 32 p
(Memo-INF-91-14; ISSN-0923-1714; ETN-91-99695) Avail: NTIS HC/MF A03

A general class of basic linear data structures for storage allocation in attribute evaluators is presented. For simple multipass evaluators stacks and queues are shown to be sufficient for storing the instances of an applied attribute occurrence with respect to two consecutive uses. Sufficient in the sense that these instances can be allocated to a stack or a queue if and only if they can be allocated to some basic linear data structure. This does not hold for simple multisweep evaluators. Necessary and sufficient conditions are given to decide whether a given simple multivisit evaluator can allocate the instances of an applied occurrence to a global variable, stack, or queue. These conditions can be checked in polynomial time. ESA

61 COMPUTER PROGRAMMING AND SOFTWARE

Includes computer programs, routines, alogorithms, and specific applications, e.g., CAD/CAM.

N91-30724# Air Force Inst. of Tech., Wright-Patterson AFB, OH.
THE DEVELOPMENT OF AN EXPERT SYSTEM FOR SOFTWARE COST ESTIMATION M.S. Thesis
James L. Goodson Sep. 1990 123 p
(AD-A229305; AFIT/GLM/LSM/90S-21) Avail: NTIS HC/MF A06 CSCL 12/5

Software development has become an integral part of new weapon system design as sophisticated computer operating control systems have proliferated. Concurrently, there has been an ever increasing requirement to accurately forecast system development costs. Experts use complicated software cost estimating tools which are difficult for novice analysts to use. Expert system technology appears to be able to bridge this gap. Policy makers have become intrigued by the potential offered by the development of expert systems in today's weapon systems for system support and development and operational utility. The primary objective of this thesis was to gather expert knowledge in software cost estimation and integrate it with a powerful analytical software cost estimation algorithm. A battery of questions were given to the experts to elicit responses relative to their knowledge of software cost estimation. Responses were integrated with algorithms with the detailed COCOMO cost estimation model. The expert system designed in this thesis provides software developers, program managers, and cost analysts an easy mechanism for determining software development costs. It provides an intelligent preprocessor, numeric algorithms and an intelligent post processor in one tool. The expert system can help the novice make accurate estimates and speed the process for experts. GRA

N91-30725# Unisys Corp., Reston, VA.
REUSABILITY LIBRARY FRAMEWORK (RLF)
James J. Solderitsch, William Bredbenner, Timothy Schreyer, Ray McDowell, and Keith Cassell 27 Jul. 1990 7 p
(Contract F19628-88-D-0031)
(AD-A229308; GR-7670-1165(NP)) Avail: NTIS HC/MF A02 CSCL 12/5

An overview is provided for the R-increment enhancements to the Reusability Library Framework (RLF) software. This software was developed in its original form under the STARS Foundations program. This delivery includes modifications to the RLF software in several key areas and are briefly described. Additional information can be found in README files within the various subdirectories that comprise this delivery. In particular, these README files contain information necessary to install the software for evaluation purposes. The user manuals for each of the major subsystems included in this delivery remain in their original STARS Foundations form. GRA

N91-30726# Unisys Corp., Reston, VA. Tactical Systems Div.
UR40: REPOSITORY INTEGRATION LIBRARIAN SOFTWARE (USER'S MANUAL), VOLUME 1 Final Report
James J. Solderitsch 17 Aug. 1990 79 p
(Contract F19628-88-D-0031)
(AD-A229313; STARS-RC-01210/001/00-Vol-1; GR-7670-1171(NP)-Vol-1) Avail: NTIS HC/MF A05 CSCL 12/5

AdaTAU is the inferencing subsystem included in the RLF. TAU stands for Think, Ask, Update which is a summary of the inferencing approach taken by AdaTAU. The manual describes how to install AdaTAU, provides a brief background for the current structure of the AdaTAU system and provides a list of the programmatic interfaces available within AdaTAU. Advice is given to users for configuring applications to make use of AdaTAU. A sample session showing the use of the included AdaTAU test harness is also included. The manual closes with a description of the specification language used to define inference bases. The Librarian is a knowledge-based tool developed as part of the Reusability Library Framework project. The information needed to use the Librarian is provided to explore the contents of a software component library as well as the information needed to modify such a library. GRA

N91-30727# Unisys Corp., Reston, VA.
SOFTWARE TECHNOLOGY FOR ADAPTABLE, RELIABLE SYSTEMS (STARS)
2 Nov. 1990 54 p
(Contract F19628-88-D-0031)
(AD-A229349; STARS-RC-01430/001/00; GR-7670-1158(NP))
Avail: NTIS HC/MF A04 CSCL 12/5

The requirements are analyzed of the STARS environment from the perspective of intermediate language use and programmatic access to compiler information. Several strategies are detailed for intermediate language use in an environment for the purpose of tight integration of tool suites. In addition a detailed analysis of the currently available STARS (Software Technology for Adaptable Reliable Systems) intermediate languages is presented. These include DIANA (Descriptive Intermediate Attributed Notation for Ada), IRIS (Intermediate Representation Including Semantics), and ASIS (Ada Semantics Interface Specification). The detailed analysis compares each intermediate language with the purposes with which it was designed and the overall goals of the STARS environment. A recommendation is made to standardize on a hybrid IRIS as the intermediate language and ASIS as a programmatic interface. A strategy is provided to accomplish the standardization. An appendix with examples of intermediate language use is included. GRA

N91-30728# Unisys Corp., Reston, VA.
SOFTWARE TECHNOLOGY FOR ADAPTABLE, RELIABLE SYSTEMS (STARS)
Kurt C. Wallnau 2 Nov. 1990 30 p
(Contract F19628-88-D-0031)
(AD-A229350; STARS-RC-01030/001/00; GR-7670-1150(NP))
Avail: NTIS HC/MF A03 CSCL 12/5

Conventions are defined for development of effective application user interfaces. The guide is intended for use by application developers and user interface developers using the Unisys STARS (Software Technology for Adaptable Reliable Systems) Ada/X User Interface Software. The intent is to produce a consistent style among Ada applications. The Style Guide addresses three areas of style: (1) application/user interactions of dialogues; (2) conventions for developing applications; and (3) formal and informal user interface standardization efforts. GRA

N91-30729# Unisys Corp., Reston, VA. Tactical Systems Div.
SOFTWARE TECHNOLOGY FOR ADAPTABLE, RELIABLE SYSTEMS (STARS) (USER MANUAL). Ada COMMAND ENVIRONMENT (ACE) VERSION 8.0 SUNOS IMPLEMENTATION Final Report
William P. Loftus and John A. Thalhammer 29 Oct. 1990 150 p
(Contract F19628-88-D-0031)
(AD-A229400; GR-7670-1141(NP); STARS-RC-00980/001/00)
Avail: NTIS HC/MF A07 CSCL 12/5

The Ada Command Environment (ACE) is an interactive command language environment for Ada software development. Ada is both the programming language and the command language used within ACE. The paradigm and philosophy used by the Ada programmer during program development are extended into the environment in which program development takes place. ACE is modeled after other interactive programming environments, such as Smalltalk and Interlisp, which are touted for individual programmer productivity. Whereas other interactive programming environments are targeted toward programming-in-the-small, ACE supports programming-in-the-large techniques that are key elements of the Ada language. This document assumes the user has a basic understanding of the Ada language, including its concept and the use of Ada for software design and development. This document is not tutorial in nature with regards to the Ada language. The user is directed to one of the many texts on Ada or the Ada Language Reference Manual for background Ada. GRA

N91-30730# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Systems and Logistics.
CPR SOFTWARE ANALYSIS: DETERMINING THE IDEAL SOFTWARE M.S. Thesis
Terry V. Smith Sep. 1990 129 p
(AD-A229499; AFIT/GCA/LSY/90S-8) Avail: NTIS HC/MF A07 CSCL 12/5

The purpose of this thesis was to determine the ideal personal computer (PC)-based Cost Performance Report (CPR) analysis software package currently available. In conducting this study, evaluation criteria needed to be selected for analyzing the software. In order to establish what criteria were to be used in evaluating the CPR analysis software, two questionnaires were sent to Air Force Systems Command product divisions. The first questionnaires asked the users what features would be useful and/or ideal in a CPR analysis software package. The second questionnaire then asked the users to rank order the criteria established from the first questionnaire. The final evaluation criteria were then selected based on an analysis of the responses to the second questionnaire. Upon selection of the criteria, four PC-based CPR analysis software packages were evaluated against those criteria. Further analysis of the CPR software packages was conducted on a decision support software package, Expert Choice. Expert Choice ranked the CPR software packages with respect to the evaluation criteria established. A sensitivity analysis was also performed with regard to the importance of the evaluation criteria in ranking the software packages. GRA

N91-30731# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Systems and Logistics.
A COMPARISON OF SOFTWARE SCHEDULE ESTIMATORS M.S. Thesis
Bryan A. Daly Sep. 1990 106 p
(AD-A229532; AFIT/GCA/LSQ/90S-1) Avail: NTIS HC/MF A06 CSCL 12/5

Accurate schedule estimation in software development programs is important because schedule is a major determinant of cost. Further, as a greater percentage of weapon system cost is taken by software, there is a greater need for knowledge in this area. In order to verify the accuracy of schedule prediction for software development obtainable today, this effort examined five commercially available software cost/schedule estimators. The estimated results were analyzed for their accuracy in predicting the actual schedules experienced on the projects. The models analyzed were REVIC, PRICE-S, System-4, SPQR/20, and SEER. GRA

N91-30732# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Systems and Logistics.
ANALYSIS OF THE EFFECT OF CURRICULUM STRUCTURE ON STUDENT PERFORMANCE MEASURES IN A COMPUTER-BASED INSTRUCTIONAL ENVIRONMENT M.S. Thesis
James F. Altensee Sep. 1990 128 p
(AD-A229544; AFIT/GSM/LSR/90S-1) Avail: NTIS HC/MF A07 CSCL 05/6

Recent experiments emphasize the need for further research to determine how to design and use computer-based instruction (CBI) with maximum effectiveness. This research addresses that need by investigating the differences caused by top-down or deductive and bottom-up or inductive curriculum (lesson) structuring in self-paced CBI. Three research variables were measured to investigate these differences: student learning (measured by performance testing), CBI course completion time, and student attitude toward the learning experience. Computer programs, written for each curriculum structure using BASIC programming language, were administered to students at the Air Force Institute of Technology in post-test randomized design experiments. Descriptive statistics and nonparametric tests were used to analyze these results. The nonparametric tests showed that the data was not statistically significant for any of the three variables. This key finding indicated that CBI educators can use either curriculum structure with almost equal effect. GRA

N91-30733# Air Force Inst. of Tech., Wright-Patterson AFB, OH.
SOFTWARE REUSABILITY: A STUDY OF WHY SOFTWARE REUSE HAS NOT DEVELOPED INTO A VIABLE PRACTICE IN THE DEPARTMENT OF DEFENSE M.S. Thesis
Brian W. Holmgren Sep. 1990 158 p
(AD-A229551; AFIT/GSM/LSY/90S-16) Avail: NTIS HC/MF A08 CSCL 12/5

Recent events, the DOD Software Master Plan and the new DARPA initiatives, have indicated a renewed interest in DOD to implement an effective software reuse program. Although this goal was attempted previously, it met with poor results. Three possible explanations of why reuse has not become a viable practice in the DOD were posited. The first explanation was that reuse in the DOD failed because there was no single higher order language; the second explanation was that reuse failed solely because of the barriers inhibiting it; and the hypothesized explanation was that reuse failed because DOD did not follow an adequate change strategy based on a change model from organizational design literature. The literature was examined in light of the three possible explanations, and a telephone survey was performed to gain further evidence from personnel, both inside and outside the DOD, that are involved in reuse connected with the DOD. The results of the phone survey were analyzed in a qualitative manner based on the literature review, and then each possible explanation was analyzed against both the literature and survey results. The hypothesized explanation was deemed to provide the best fit. GRA

N91-30734# Air Force Inst. of Tech., Wright-Patterson AFB, OH.
AN INTERACTIVE SYSTEM OF COMPUTER GENERATED GRAPHIC DISPLAYS FOR MOTIVATING MEANINGFUL LEARNING OF MATRIX OPERATIONS AND CONCEPTS OF MATRIX ALGEBRA M.S. Thesis
Stone W. Hansard Sep. 1990 186 p
(AD-A229557; AFIT/GSM/ENC/90S-12) Avail: NTIS HC/MF A09 CSCL 12/5

This thesis evaluated students' responses to a teaching method designed to involve students and teachers of mathematics in a meaningful learning experience using a system that allowed the student to participate in discovery learning. The system was comprised of a computer program that motivated visualization of

concepts of matrix algebra, and a procedure that encouraged the students to verbalize each concept, create an algorithm for the matrix operation, and discover a mathematical formula that described the process for each operation. The teaching system is based on modern learning theory and reflects several recommendations made by the Commission on Standards for School Mathematics to the National Council of Teachers of Mathematics (NCTM). Of the 40 students who participated in the survey, over 87 percent felt the matrix program was more interesting than an ordinary lecture; 80 percent felt the system was more fun than reading a textbook; and 92 percent indicated they would use a learning tool similar to the matrix computer program if given the opportunity. Over 82 percent of the students believed the matrix teaching system helped them learn matrix algebra, while 72 percent felt the teaching system helped them learn matrix algebra better than they would have under typical classroom conditions. GRA

N91-30735# Advance Design Information, Inc., Sherman Oaks, CA.
DESIGN OF AN INSTRUCTIONAL STRATEGY TO TEACH VISUALIZATION IN AN ADVECTION CONTEXT IN INTELLIGENT COMPUTER-ASSISTED INSTRUCTION Interim Paper, Jan. 1990 - Mar. 1991
Harold F. ONeil, Jr. May 1991 96 p
(Contract F33615-89-C-0006)
(AD-A235942; AL-TP-1991-0012) Avail: NTIS HC/MF A05 CSCL 12/5

This document contains the domain-independent instructional strategy to teach a cognitive strategy and its associated instantiation for a visualization strategy in the domain of weather. Further, rules and implementation suggestions are provided to support a design for an implementation of an intelligent computer-assisted instruction (ICAI) program to teach approximately an hour of the domain of advection. Advection is the process that transports atmospheric properties (e.g., temperature) by the wind. Advection is usually used to describe large-scale horizontal movement in the atmosphere. The vertical motions of the atmosphere can be inferred by finding the proper advection patterns. Ultimately, it is the vertical motions in the atmosphere that produce the changes in weather. GRA

N91-30736# Metrica, Inc., San Antonio, TX.
THE INTEGRATED DECISION MODELING SYSTEM (IDMS) USER'S MANUAL Final Technical Paper, Mar. 1989 - Feb. 1991
Jonathan C. Fast, John N. Taylor, and Larry T. Looper May 1991 105 p
(Contract F41689-88-D-0251)
(AD-A236033; AL-TP-1991-0009) Avail: NTIS HC/MF A06 CSCL 12/5

The Integrated Decision Modeling System (DMS) is a prototype computer based decision aid which incorporates a user interface to help the decision maker analyze a problem, determine the most appropriate decision aiding tool, and utilize the selected tool. Each of the four decision aiding models as well as the user interface and sensitivity analysis modules are presented in appendices which discuss the technique, provide examples of their use, and instruct the user as to how to access each through the computer. GRA

N91-30737# CEA, Inc., Canton, MA.
AN INTELLIGENT COMPUTER-TO-COMPUTER TRANSMISSION PACKAGE Report, Feb. 1989 - May 1990
Marcelle Hajjar and Peter Frasca Jun. 1990 11 p
(Contract F19628-88-D-0027)
(PB91-163055; CEA-90/1; ESD-90-TR-872) Avail: NTIS HC/MF A03 CSCL 09B

An intelligent computer to computer transmission package was designed and implemented using the PROCOMM PLUS communications program to transfer data from one computer to another. The package permits a noncomputer literate person to accomplish communications tasks. The package provides automatic adjustment of baud rate, communications port number, data compression/decompression, single or multiple file transmission, and communications protocol handling. The package is designed for Hayes compatible modems and transfer of graphic, text, or binary data. Author

N91-30738*# Princeton Univ., NJ. Dept. of Astrophysical Sciences.
M.S.L.A.P. MODULAR SPECTRAL LINE ANALYSIS PROGRAM DOCUMENTATION Final Report
Charles L. Joseph and Edward B. Jenkins 1991 119 p
(Grant NAGw-1915)
(NASA-CR-188713; NAS 1.26:188713) Copyright Avail: NTIS HC/MF A06 CSCL 09B

MSLAP is a software for analyzing spectra, providing the basic structure to identify spectral features, to make quantitative measurements of this features, and to store the measurements for convenient access. MSLAP can be used to measure not only the zeroth moment (equivalent width) of a profile, but also the first and second moments. Optical depths and the corresponding column densities across the profile can be measured as well for sufficiently high resolution data. The software was developed for an interactive, graphical analysis where the computer carries most of the computational and data organizational burden and the investigator is responsible only for all judgement decisions. It employs sophisticated statistical techniques for determining the best polynomial fit to the continuum and for calculating the uncertainties. Author

N91-30739*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
SOFTWARE FOR OPTICAL ARCHIVE AND RETRIEVAL (SOAR) USER'S GUIDE, VERSION 4.2
Charles Davis (ST Systems Corp., Lanham, MD.) Apr. 1991 54 p
(NASA-TM-105039; NAS 1.15:105039;
NSSDC/WDC-A-R/S-91-06) Avail: NTIS HC/MF A04 CSCL 09B

The optical disk is an emerging technology. Because it is not a magnetic medium, it offers a number of distinct advantages over the established form of storage, advantages that make it extremely attractive. They are as follows: (1) the ability to store much more data within the same space; (2) the random access characteristics of the Write Once Read Many optical disk; (3) a much longer life than that of traditional storage media; and (4) much greater data access rate. Software for Optical Archive and Retrieval (SOAR) user's guide is presented. Author

N91-30740*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
THE SPAN COOKBOOK: A PRACTICAL GUIDE TO ACCESSING SPAN
Stephanie Mason, Ronald D. Tencati, David M. Stern, Kimberly D. Capps, Gary Dorman (RMS Technologies, Inc., Landover, MD.), and David J. Peters 10 Aug. 1990 58 p
(NASA-TM-105054; NSSDC/WDC-A-R/S-90-21; NAS 1.15:105054) Avail: NTIS HC/MF A04 CSCL 09B

This is a manual for remote users who wish to send electronic mail messages from the Space Physics Analysis Network (SPAN) to scientific colleagues on other computer networks and vice versa. In several instances more than one gateway has been included for the same network. Users are provided with an introduction to each network listed with helpful details about accessing the system and mail syntax examples. Also included is information on file transfers, remote logins, and help telephone numbers. J.P.S.

N91-30741*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
SPAN SECURITY POLICIES AND GUIDELINES
Patricia L. Sisson (Science Applications Research, Lanham, MD.) and James L. Green 24 Oct. 1989 61 p
(NASA-TM-105071; NSSDC/WDC-A-R/S-89-21; NAS 1.15:105071) Avail: NTIS HC/MF A04 CSCL 09B

A guide is provided to system security with emphasis on requirements and guidelines that are necessary to maintain an

acceptable level of security on the network. To have security for the network, each node on the network must be secure. Therefore, each system manager, must strictly adhere to the requirements and must consider implementing the guidelines discussed. There are areas of vulnerability within the operating system that may not be addressed. However, when a requirement or guideline is discussed, implementation techniques are included. Information related to computer and data security is discussed to provide information on implementation options. The information is presented as it relates to a VAX computer environment. Author

N91-30742*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
THE NASA MASTER DIRECTORY: QUICK REFERENCE GUIDE
Karen Satin, ed. and Carol Kanga, ed. Nov. 1989 13 p
(NASA-TM-105070; NAS 1.15:105070; NSSDC/WDC-A-R/S-89-19) Avail: NTIS HC/MF A03 CSCL 09B

This is a quick reference guide to the NASA Master Directory (MD), which is a free, online, multidisciplinary directory of space and Earth science data sets (NASA and non-NASA data) that are of potential interest to the NASA-sponsored research community. The MD contains high-level descriptions of data sets, other data systems and archives, and campaigns and projects. It provides mechanisms for searching for data sets by important criteria such as geophysical parameters, time, and spatial coverage, and provides information on ordering the data. It also provides automatic connections to a number of data systems such as the NASA Climate Data System, the Planetary Data System, the NASA Ocean Data System, the Pilot Land Data System, and others. The MD includes general information about many data systems, data centers, and coordinated data analysis projects, It represents the first major step in the Catalog Interoperability project, whose objective is to enable researchers to quickly and efficiently identify, obtain information about, and get access to space and Earth science data. The guide describes how to access, use, and exit the MD and lists its features. Author

N91-30743*# Transylvania Univ., Lexington, KY.
ISOTHERMAL THERMOGRAVIMETRIC DATA ACQUISITION ANALYSIS SYSTEM Final Report
Kenneth Cooper, Jr. Aug. 1991 64 p Sponsored by NASA. Lewis Research Center
(NASA-CR-187171; E-6474; NAS 1.26:187171) Avail: NTIS HC/MF A04 CSCL 09B

The description of an Isothermal Thermogravimetric Analysis (TGA) Data Acquisition System is presented. The system consists of software and hardware to perform a wide variety of TGA experiments. The software is written in ANSI C using Borland's Turbo C++. The hardware consists of a 486/25 MHz machine with a Capital Equipment Corp. IEEE488 interface card. The interface is to a Hewlett Packard 3497A data acquisition system using two analog input cards and a digital actuator card. The system provides for 16 TGA rigs with weight and temperature measurements from each rig. Data collection is conducted in three phases. Acquisition is done at a rapid rate during initial startup, at a slower rate during extended data collection periods, and finally at a fast rate during shutdown. Parameters controlling the rate and duration of each phase are user programmable. Furnace control (raising and lowering) is also programmable. Provision is made for automatic restart in the event of power failure or other abnormal terminations. Initial trial runs were conducted to show system stability. Author

N91-30744# Computational Mechanics Co., Austin, TX.
NON-ALGORITHMIC ISSUES IN AUTOMATED COMPUTATIONAL MECHANICS Final Report, 1 Mar. 1989 - 18 Feb. 1991
W. W. Tworzydlo, J. T. Oden, J. M. Bass, J. Combs, and S. Sheikh 30 Apr. 1991 180 p
(Contract F49620-89-C-0015)
(AD-A238322; TR-91-09; AFOSR-91-0603TR) Avail: NTIS HC/MF A09 CSCL 12/3

The goal was to study the feasibility of the development of an automatic environment for engineering design of aerospace structures, in particular for their analysis by the finite element method. Of particular interest were non-algorithmic issues related to automated decision making based on heuristics and expertise. The types of knowledge and decisions involved in the design process were studied, and computer technologies best suited for their automation were evaluated. These technologies include algorithmic procedures, knowledge based expert systems, neural networks, knowledge acquisition systems, etc. The main thrust of research was focused on the development and extension of concepts related to automated computational mechanics, such as adaptive computational techniques, automated model and strategy selection, automated performance monitoring and quality assurance for the finite element analysis. These methods were implemented in an automated computational environment, based on full coupling of h-p adaptive finite element program with expert systems technology. Several examples of automated decision making in finite element analysis prove the feasibility and great practical potential of automated environments for design of aerospace structures. Based on the studies, directions of further research and development in this area were identified. GRA

N91-30745* Georgia Univ., Athens. Computer Software Management and Information Center.
COSMIC SOFTWARE CATALOG, 1991 EDITION Abstracts Only
1991 465 p
(Contract NASw-4194)
(NASA-CR-187366; NAS 1.26:187366) Avail: COSMIC, Athens, GA, 30602 $25.00 CSCL 09B

A catalog listing over 1200 computer programs available from the Computer Software Management and Information Center is presented. The programs cover several fields including energy technology; chemical, mechanical, and aeronautical engineering; management; and computer technology. Abstracts, a key word index, and a subject category index are included. In addition, for each program, information on programming languages, machine requirements, program size, and distribution media is given. Author

N91-30746# National Inst. of Standards and Technology, Gaithersburg, MD.
TILED RASTER GRAPHICS AND MIL-R-28002A: A TUTORIAL AND IMPLEMENTATION GUIDE
F. E. Spielman and L. H. Sharpe Apr. 1991 106 p Prepared for Assistant Secretary of Defense (Production and Logistics), Washington
(PB91-187708; NISTIR-4567) Avail: NTIS HC/MF A06 CSCL 09B

The technical issues facing an implementor of the raster data interchange format defined in military specification MIL-R-28002A are examined. Information previously scattered throughout several standards is incorporated for ease of reference. The National Institute of Standards and Technology Office Document Architecture Raster Document Application Profile (NIST ODA Raster DAP) is analyzed with regard to both notation and intent. Author

N91-30747*# Hawaii Univ., Manoa. Dept. of Electrical Engineering.
MULTI-STAGE DECODING FOR MULTI-LEVEL BLOCK MODULATION CODES
Shu Lin and Tadao Kasami 27 Aug. 1991 38 p
(Grant NAG5-931)
(NASA-CR-188759; NAS 1.26:188759; NASA-91-002) Avail: NTIS HC/MF A03 CSCL 09B

Various types of multistage decoding for multilevel block modulation codes, in which the decoding of a component code at each stage can be either soft decision or hard decision, maximum likelihood or bounded distance are discussed. Error performance for codes is analyzed for a memoryless additive channel based on various types of multi-stage decoding, and upper bounds on

the probability of an incorrect decoding are derived. It was found that, if component codes of a multi-level modulation code and types of decoding at various stages are chosen properly, high spectral efficiency and large coding gain can be achieved with reduced decoding complexity. It was found that the difference in performance between the suboptimum multi-stage soft decision maximum likelihood decoding of a modulation code and the single stage optimum decoding of the overall code is very small, only a fraction of dB loss in SNR at the probability of an incorrect decoding for a block of 10(exp -6). Multi-stage decoding of multi-level modulation codes really offers a way to achieve the best of three worlds, bandwidth efficiency, coding gain, and decoding complexity. Author

N91-30748*# Research Triangle Inst., Research Triangle Park, NC. Electromagnetics Research Dept.
USER MANUAL FOR TWO SIMPLE POSTSCRIPT OUTPUT FORTRAN PLOTTING ROUTINES Interim Report
T. X. Nguyen Aug. 1991 38 p
(Contract NAS1-18925)
(NASA-CR-187590; NAS 1.26:187590; RTI/4500/004-01I) Avail: NTIS HC/MF A03 CSCL 09B

Graphics is one of the important tools in engineering analysis and design. However, plotting routines that generate output on high quality laser printers normally come in graphics packages, which tend to be expensive and system dependent. These factors become important for small computer systems or desktop computers, especially when only some form of a simple plotting routine is sufficient. With the Postscript language becoming popular, there are more and more Postscript laser printers now available. Simple, versatile, low cost plotting routines that can generate output on high quality laser printers are needed and standard FORTRAN language plotting routines using output in Postscript language seems logical. The purpose here is to explain two simple FORTRAN plotting routines that generate output in Postscript language. Author

N91-30749*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
ASYNCHRONOUS AND CORRECTED-ASYNCHRONOUS NUMERICAL SOLUTIONS OF PARABOLIC PDES ON MIMD MULTIPROCESSORS Final Report
Dganit Amitai, Amir Averbuch, Samuel Itzikowitz, and Eli Turkel (Tel-Aviv Univ., Israel) Jul. 1991 24 p Presented at the 4th SIAM Conference on Parallel Processing for Scientific Computing, Chicago, IL, 11-13 Dec. 1989 Submitted for publication Sponsored in part by National Council for Research and Development
(Contract NAS1-18605)
(NASA-CR-187605; NAS 1.26:187605; ICASE-91-59) Avail: NTIS HC/MF A03 CSCL 09B

A major problem in achieving significant speed-up on parallel machines is the overhead involved with synchronizing the concurrent process. Removing the synchronization constraint has the potential of speeding up the computation. The authors present asynchronous (AS) and corrected-asynchronous (CA) finite difference schemes for the multi-dimensional heat equation. Although the discussion concentrates on the Euler scheme for the solution of the heat equation, it has the potential for being extended to other schemes and other parabolic partial differential equations (PDEs). These schemes are analyzed and implemented on the shared memory multi-user Sequent Balance machine. Numerical results for one and two dimensional problems are presented. It is shown experimentally that the synchronization penalty can be about 50 percent of run time: in most cases, the asynchronous scheme runs twice as fast as the parallel synchronous scheme. In general, the efficiency of the parallel schemes increases with processor load, with the time level, and with the problem dimension. The efficiency of the AS may reach 90 percent and over, but it provides accurate results only for steady-state values. The CA, on the other hand, is less efficient, but provides more accurate results for intermediate (non steady-state) values. Author

N91-30750*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
RECTILINEAR PARTITIONING OF IRREGULAR DATA PARALLEL COMPUTATIONS
David M. Nicol (College of William and Mary, Williamsburg, VA.) Jul. 1991 30 p Submitted for publication
(Contract NAS1-18605; NAG1-787; NAG1-1132; NSF ASC-88-19373)
(NASA-CR-187601; NAS 1.26:187601; ICASE-91-55) Avail: NTIS HC/MF A03 CSCL 09B

New mapping algorithms for domain oriented data-parallel computations, where the workload is distributed irregularly throughout the domain, but exhibits localized communication patterns are described. Researchers consider the problem of partitioning the domain for parallel processing in such a way that the workload on the most heavily loaded processor is minimized, subject to the constraint that the partition be perfectly rectilinear. Rectilinear partitions are useful on architectures that have a fast local mesh network. Discussed here is an improved algorithm for finding the optimal partitioning in one dimension, new algorithms for partitioning in two dimensions, and optimal partitioning in three dimensions. The application of these algorithms to real problems are discussed. Author

N91-30751*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
EMPIRICAL PREDICTIONS OF HYPERVELOCITY IMPACT DAMAGE TO THE SPACE STATION
W. K. Rule (Alabama Univ., Tuscaloosa.) and K. B. Hayashida Jul. 1991 40 p
(NASA-TM-103550; NAS 1.15:103550) Avail: NTIS HC/MF A03 CSCL 09B

A family of user-friendly, DOS PC based, Microsoft BASIC programs written to provide spacecraft designers with empirical predictions of space debris damage to orbiting spacecraft is described. The spacecraft wall configuration is assumed to consist of multilayer insulation (MLI) placed between a Whipple style bumper and the pressure wall. Predictions are based on data sets of experimental results obtained from simulating debris impacts on spacecraft using light gas guns on Earth. A module of the program facilitates the creation of the data base of experimental results that are used by the damage prediction modules of the code. The user has the choice of three different prediction modules to predict damage to the bumper, the MLI, and the pressure wall. One prediction module is based on fitting low order polynomials through subsets of the experimental data. Another prediction module fits functions based on nondimensional parameters through the data. The last prediction technique is a unique approach that is based on weighting the experimental data according to the distance from the design point. Author

N91-30752# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
OOSY: AN OBJECT ORIENTED OPERATING SYSTEM [OOSY, EEN OBJECT ORIENTED OPERATING SYSTEM]
J. J. Luursema Dec. 1990 39 p In DUTCH; ENGLISH summary
(Memo-INF-90-78; ISSN-0923-1714; ETN-91-99669) Avail: NTIS HC/MF A03

The object oriented system OOSY is described. It is a simple miltitask system, written in the object oriented language TURBO PASCAL 5.5. The system exists of three layers. The bottom layer (process administration, scheduling, interrupts, etc.) is largely based on the personal computer version of PRAKSYS. The second layer handles input and output of processes through so called channels. The use of objects makes it relatively simple to create powerful and device independent input/output facilities. The third layer, still under construction, contains a command shell and methods to fork processes with arbitrary parameter structures. ESA

N91-30753# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
APL IMPLEMENTATION TECHNIQUES

H. G. Posthuma Jan. 1991 41 p In DUTCH; ENGLISH summary
(Memo-INF-91-03; ISSN-0923-1714; ETN-91-99685) Avail: NTIS HC/MF A03

APL implementation techniques concerning time and space in terms of computer efficiency are dealt with. The main objective is to provide general guidelines to optimize the use of APL primitive functions and operators as well as APL data, with special attention to techniques of avoiding branches and loops. The possible decision structures in APL are described. Special reference is given to APL for a PC (Personal Computer), and the examples were coded and timed in STSC's APL PLUS PC version 9.1 on an Olivetti M24 PC. Some examples were also timed in I.P. Sharp's APL/PL 240 version 1 on the same machine. ESA

N91-30754# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
A TRIPLE JUMP FLOW CHART [EEN HINK-STAP-SPRONG FLOWCHART TECHNIEK]
W. A. Vervoort Apr. 1991 16 p In DUTCH
(Memo-INF-91-28; ISSN-0923-1714; ETN-91-99707) Avail: NTIS HC/MF A03

A novel flow chart technique, the triple jump, developed with a view to programming education is described. The technique is an informal method based on an invariant, to support the design of repetition constructions in programs. The flow chart represents in three phases the convergence of the invariant in time. A systematic tackling of the problems aims at answering three questions (triple jump) after the design of the invariant. The questions relate to the initialization, a convergence step, and the stopping of the repetition. A repetion algorithm is deduced from the flow chart. ESA

N91-30755# Royal Signals and Radar Establishment, Malvern (England).
Z USAGE AND ABUSAGE
R. Macdonald Feb. 1991 44 p
(RSRE-91003; BR116690; ETN-91-99839) Copyright Avail: NTIS HC/MF A03

A miscellany of observations drawn from experience of using Z are presented. A variety of techniques for expressing certain classes of idea concisely and clearly are shown and certain pitfalls which may trap the unwary user are highlighted. A familarity with the Z notation and the modeling of operations using the state machine style, including error handling is assured. ESA

N91-30756# Royal Signals and Radar Establishment, Malvern (England).
TDF SPECIFICATION
J. M. Foster, M. Brandreth, P. W. Core, I. F. Currie, and N. E. Peeling Oct. 1990 139 p
(RSRE-91005; BR301954; ETN-91-99840) Copyright Avail: NTIS HC/MF A07

TDF is an intermediate format for distributing software applications. This is primarily a reference manual which precisely defines the meaning of TDF. An extended introduction explains the purpose of TDF and gives an overview of its structure. It also explains those concepts within the definition which may be new to the reader and defines terminology used in the rest of the document. Some discussion sections are included among the definitions of TDF constructs. These can be read independently of the definitions and are intended to provide the reader with a broader perspective of particular areas of TDF. ESA

N91-30757# Royal Signals and Radar Establishment, Malvern (England).
BIDIRECTIONALITY, CONNECTIVITY, AND INSTANTIATIONS IN ELLA
M. G. Hill, E. V. Whiting, and J. D. Morison Mar. 1991 32 p
(RSRE-Memo-4421; BR116741; ETN-91-99842) Copyright Avail: NTIS HC/MF A03

Language enhancements to the ELLA function type mechanism together with enhancements for the multiple instantiation of functions and the connectivity of circuits are discussed. The syntactic and semantic definition of the new features together with examples of their use are presented. ESA

N91-30758# Royal Signals and Radar Establishment, Malvern (England).
ELLA CONNECTIVITY CONTROL
M. G. Hill Feb. 1991 23 p
(RSRE-Memo-4462; BR116643; ETN-91-99845) Copyright Avail: NTIS HC/MF A03

The enhancements to the internal data structure of the ELLA compiler for the holding and checking of the connectivity information within an ELLA design are described. The consequence of this work on the rest of the ELLA system is discussed. ESA

N91-30759# Royal Signals and Radar Establishment, Malvern (England).
TRIAL IMPLEMENTATION OF A SECURE APPLICATION USING TEN15
Elizabeth R. Bilsby Mar. 1991 47 p
(RSRE-Memo-4465; BR301184; ETN-91-99847) Copyright Avail: NTIS HC/MF A03

How a subset of SERCUS was implemented using Ten15 is described. SERCUS is a research implementation of a multi level secure workstation based on the SMITE approach and running a classified document handling application. SMITE is an approach to the construction of secure systems which uses strong typing. Ten15 is an algebraically defined, strongly typed abstract machine running on a VAX station. ESA

N91-30760# Royal Aerospace Establishment, Farnborough (England).
A PROCEDURE FOR THE SOLUTION OF LAMBERT'S ORBITAL BOUNDARY-VALUE PROBLEM
R. H. Gooding 7 Mar. 1991 40 p Repr. from Celestial Mechanisms, v. 48, 1990 p 145-165
(RAE-TM-Space-378; BR300706; ETN-91-99849) Copyright Avail: NTIS HC/MF A03

A procedure that provides a universal solution of Lambert's problem is described. The procedure uses Halley's cubic iteration process to evaluate the unknown parameter, x, at the heart of the approach, initial estimates for x being selected so that three iterations of the process always suffice to yield an accurate value. The overall procedure was implemented via three FORTRAN 77 subroutines, listings of which are appended, and the way in which the subroutines were tested is outlined. ESA

N91-30761# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.).
UTILIZATION OF COMPUTER AIDED DESIGN (CAD)/COMPUTER AIDED ENGINEERING (CAE) SYSTEMS IN AN AIRCRAFT INDUSTRIAL PLANT [PRAXISBERICHT UEBER DEN OPTIMIERTEN EINSATZ VON CAD-/CAE- IN EINEM WERK DER FLUGZEUGINDUSTRIE]
Manfred Seiler 1990 24 p In GERMAN Presented at the 19th International Finite Elemente Kongress FEM 1990, Baden-Baden, Fed. Republic of Germany, 19-20 Nov. 1990
(MBB-UD-0583-90-PUB; OTN-030805; ETN-91-99445) Avail: NTIS HC/MF A03

It is shown that proper optimization and adaptation between the different systems are necessary for an efficient configuration of all processes, from model construction to complete documentation. The increasing use of CAE systems necessitates an increasing electronic data processing specific control within the utilization field. The use of a personal computer with host emulation proved to be efficient. The process chain required the control of up to ten systems for dependable tasks. This aspects and the necessary qualification of the workers is not to be underrated, in the intensification of the CAE system utilization. ESA

N91-30762# Sheffield Univ. (England). Dept. of Control Engineering.
A PREDICTION-ERROR ESTIMATION ALGORITHM FOR THE RECONSTRUCTION OF LINEAR AND NONLINEAR CONTINUOUS TIME MODELS FROM FREQUENCY RESPONSE DATA
K. M. Tsang (Hong Kong Polytechnic, Kowloon.) and S. A. Billings Feb. 1991 8 p
(RR-421; ETN-91-99466) Avail: NTIS HC/MF A02

A prediction error estimation algorithm is derived for the estimation of complex number systems. The algorithm is applied to reconstruct both linear and nonlinear differential equation models from frequency response data. A simulation study is included to illustrate the algorithm. ESA

N91-30763# Institut National Polytechnique, Grenoble (France). Techniques de l'Information, des Mathematiques, de la Microelectronique et de la Microscopie.
THE STUDY OF A BUILT-IN SELF TEST STRATEGY FOR THE SYCO SILICON COMPILER Ph.D. Thesis [ETUDE D'UNE STRATEGIE D'AUTOTEST INTEGRE POUR LE COMPILATEUR DE SILICIUM SYCO]
Kholdoun Torki 1990 222 p In FRENCH; ENGLISH summary
(ETN-91-99475) Avail: NTIS HC/MF A10

The basic structure of the Unified Built In Self Test (UBIST) scheme is the self checking circuit. Around this self checking structure, a built In Logic Block Observation (BILBO) structure is implemented, ensuring offline phase tests, which increases multiple fault coverage and strengthens the Strongly Fault Secure (SFS) and Strongly Code Disjoint (SCD) properties for some functional blocks and checkers. A methodology for implementing UBIST scheme is proposed for hierarchical control sections built around PLA's, and parallel bit sliced datapaths. These architectures are the target architecture used by the SYCO silicon compiler. An efficient topological solution is proposed for the UBIST schemes. Test specific computed aided design tools are proposed, which are compatible with the architectural and structural specifications used by the SYCO compiler. ESA

N91-30764# Institut National Polytechnique, Grenoble (France). Techniques de l'Information, des Mathematiques, de la Microelectronique et de la Microscopie.
LOGIC SIMULATION ACCELERATION: LL3T ARCHITECTURE AND ALGORITHMS Ph.D. Thesis [ACCELERATION DE LA SIMULATION LOGIQUE. ARCHITECTURE ET ALGORITHMES DE LL3T]
Yang Wu 1990 382 p In FRENCH; ENGLISH summary
(ETN-91-99478) Avail: NTIS HC/MF A17

The design of a hardware accelerator dedicated to the simulation of integrated circuits is described. A software set was developed to form an integrated simulation ernvironment. Fundamentals of integrated circuit modeling, logic and functional simulation, fault simulation, hardware description languages, and acceleration techniques used in integrated circuit simulation are discussed. The architecture of the accelerator is presented. Based on parallel architecture, the accelerator includes a ring network on which the simulation units are disposed. The software implemented on the accelerator is examined. Both multilevel and fault simulation are realized. The multilevel simulation is carried out at gate level, functional level, and switch level. Different parallelization strategies are given for the simulation. Simulation algorithms adapted to different abstraction levels are presented. ESA

N91-30765# Institut National Polytechnique, Grenoble (France). Lab. de Modelisation et Calcul.
BASIC PRINCIPLES OF LIST SCHEDULING ALGORITHMS AND TASK SCHEDULING PRECEDENCE Ph.D. Thesis [PRINCIPES DE BASE DES ALGORITHMES D'ORDONNANCEMENT DE LISTE ET AFFECTATION DE PRIORITES AUX TACHES]
Bertrand Braschi 1990 135 p In FRENCH
(ETN-91-99479) Avail: NTIS HC/MF A07

Scheduling algorithms are examined from a deterministic point of view, in order to minimize the execution time of a set of tasks linked by precedence constraints on a finite number of identical machines. The worst behavior of algorithms using a task list is characterized, when communication times are either null or equal, with regard to task duration unit. A view on task priorities is presented, which allows Coffman and Graham results to be extended. A study on the numbers of tasks executed by a machine, when tasks are independent is carried out. ESA

N91-30766# Grenoble-1 Univ. (France). Lab. de Modelisation et Calcul.
DISTRIBUTED ALGORITHMS FOR THE INTERSECTION OF BEZIER CURVES AND SURFACES Ph.D. Thesis [ALGORITHMES DISTRIBUES POUR L'INTERSECTION DE COURBES ET SURFACES DE BEZIER]
Alain Kaufmann 1990 147 p In FRENCH; ENGLISH summary
(ETN-91-99490) Avail: NTIS HC/MF A07

The intersection of Bezier curves is a naturally parallel process because each problem is subdivided into several similar subproblems. An increasing number of processors are used during the solution localization phase. The best tested task sharing consists of satisfying the biggest number of processors. The surface/plane intersection is composed of two steps, the first one being the subdivision step, which is naturally parallel as it generates an increasing number of tasks. The second step is curve reconstruction with a decreasing number of tasks. Links are to be kept between Bezier nets in order to reconstruct the curves fast. These links imply constraints for task sharing and/or for the topology of the processor network. The experimentation shows that the neighboring links or the links of the subdivision tree give the best results. ESA

N91-30767# Grenoble-1 Univ. (France). Lab. de Genie Informatique.
COMPILATION AND VERIFICATION OF LOTOS PROGRAMS Ph.D. Thesis [COMPILATION ET VERIFICATION DE PROGRAMMES LOTOS]
Hubert Garavel 1989 274 p In FRENCH; ENGLISH summary
(ISBN-2-7261-0621-8; ETN-91-99491) Avail: NTIS HC/MF A12

A compiling technique which allows a significant subset of LOTOS (Language Of Temporal Ordering Specification) to be translated into both interpreted Petri nets and finite state automata is proposed. The translation is achieved by three successive steps, e.g., expansion, generation and simulation based on intermediate semantic models, namely SUBLOTOS language and networks. It involves a static and global analysis of program behaviors. It can handle data structures which have to be compiled by already known algorithms. These compiling principles are fully implemented in the software tool, CAESAR. Performances obtained confirm the interest of the approach. ESA

N91-30768 Politecnico di Milano (Italy). Dipartimento di Elettronica.
A NEW TIMED PETRI NET MODEL FOR HARDWARE REPRESENTATION
Giacomo Buonanno 1990 23 p
(Rept-90-064; ETN-91-99514) Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

The use of modified Petri nets for design representation is proposed. Since Petri nets in their basic form show only the causal dependencies among the events, but do not provide any concept of time, a high level net model called the Environment/Relationship (ER) net which is suitable for a unified representation and manipulation of time and data is used. The use of ER nets in hardware description is demonstrated by means of a simple but significant example: this allows the comparison of ER nets with other methods used to this purpose. In particular, ER nets are able to remove all the ambiguities that intrinsically arise in other techniques. On the basis of such case study, general rules for mapping hardware specification languages into ER nets are provided. ESA

N91-30769 Politecnico di Milano (Italy). Dipartimento di Elettronica.
MML LANGUAGE ANALYSIS [ANALISI DEL LINGUAGGIO MML]
Stefano Crespi Reghizzi, Stefano Genolini, and Alberta Ghirardi (Centro Informazioni Studi Esperienze, Milan, Italy) Jan. 1991 48 p In ITALIAN; ENGLISH summary
(Rept-91-003; ETN-91-99516) Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

MML is a language for programming embedded, multimicroprocessor systems. MML is an extension to PASCAL based on Brinch-Hansen's distributed processes and integrated with features for target configuration description, and task allocation. MME, the UNIX based MML programming environment, integrates a design data base and offers multiuser capabilities. The main features of MML, and especially its run time support are analyzed in comparison with other multitasking languages and operating system kernels intended for the same application domain. Features of MML to be modified or extended are indicated, and classified as urgent, important or just possible. Comparative performance figures are included for important concurrency related operations. ESA

N91-30770 Politecnico di Milano (Italy). Dipartimento di Elettronica.
MAX-LINEAR COMBINATORIAL OPTIMIZATION
Giovanni Righini and Alberto Colorni Jan. 1991 28 p Sponsored in part by Italian Ministry of Public Education, and Italian Ministry of University and Scientific Research
(Grant NATO-RG-85-0240)
(Rept-91-005; ETN-91-99518) Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

Every combinatorial optimization problem possesses a so called max linear form. In it, p linear cost functions C sup i are associated with the binary variables of the problem. The goal is neither the minimization of a single cost nor of their weighted sum but the minimization of the maximum cost. The corresponding objective functions is thus max (C(sup i)x) where i= 1,...p. Even when the ordinary optimization problem is in P, its max linear version is NP hard and requires the use of approximation algorithms and/or branch and bound techniques. A deterministic approximation algorithm and a branch and bound method are proposed. The branch and bound strategy allows the aproximation algorithm to be repeatedly applied to problems more and more reduced until the optimal solution is determined. ESA

N91-30771 Politecnico di Milano (Italy). Dipt. di Elettronica.
TRANSLATING EVOLUTION STRATEGIES IN GA TERMS
Marco Dorigo and Vittorio Maniezzo Feb. 1991 13 p
(Rept-91-007; ETN-91-99520) Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

Genetic algorithms (GA) and evolution strategies are compared. Some specific properties of evolution strategies were incorporated in the design of a genetic algorithm which exhibits interesting capabilities, pn particular, a self adapting mutation probability, a k order crossover i.e., a crossover operator that is applied to k individuals simultaneously, and different selection policies. Some simulation results that show how the proposed approach effectively improves the performance of the genetic algorithm are presented. ESA

N91-30772 Politecnico di Milano (Italy). Dipt. di Elettronica.
A MODULAR METHODOLOGY TO DESIGN LOGIC CONTROLLERS WITH PETRI NETS
Luca Ferrarini 1991 25 p
(Rept-91-008; ETN-91-99521) Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

A conceptual and practical methodology to design logic control systems with Petri nets is proposed. In particular, the specification formalism is based on a special version of Petri nets, tailored to represent logic controllers. The main objectives of this methodology is to reduce the design effort due to the complexity of control problems and to provide design criteria that perfectly fit the fundamental engineering approach to complexity: the incremental design. The methodology proposed is based on concepts coming from a number of theorems stated and proved. The designer is provided with particularly powerful basic net structures, implenting single control tasks, and with particularly useful connections to coordinate and synchronize these tasks the designer can face and solve simple control problems and, successively, aggregate separate designs to form a more complex structure. Thanks to the theorems stated, simple rules are provided that guarantee the preservation, after the merging of previous designs, of extremely important net properties, like boundedness, cyclicness and lifeness. To do so, it is sufficient to analyze an opportune graph based on the connections among tasks. ESA

N91-30773 Politecnico di Milano (Italy). Dipt. di Elettronica.
KNOWLEDGE BASE APPROACH TO THE SYNTHESIS OF HUMAN FIGURE MOTION IN COMPUTER ANIMATION Ph.D. Thesis [LO SVILUPPO DI UNA BASE DI CONOSCENZA PER LA SINTESI DEL MOVIMENTO DELLA FIGURA UMANA IN COMPUTER ANIMATION]
Roberto Maiocchi Feb. 1991 174 p In ITALIAN; ENGLISH summary Original contains color illustrations
(Rept-91-009; ETN-91-99522) Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

A knowledge based approach to the synthesis of human motion in computer animation is presented. The challenge of the proposal is to verify the possibility of controlling the movement of the human figure by developing a qualitative model of human motor behavior that avoids the significant calculations necessary if complex mathematical models are adopted. The most relevant characteristic of the system is that knowledge about the human figure and its motor behavior is composed dynamically to fit the task at hand. Task execution can be varied to account for the flexibility and adaptation shown by humans through the control of modeling assumptions expressing common sense knowledge about human motor behavior. Examples of motor skills implemented according to such assumptions are sitting, stepping upwards, level walking, performing a somersault, and discuss throwing. ESA

N91-30774 Politecnico di Milano (Italy). Dipt. di Elettronica.
CONSTRICTOR: A LANGUAGE FOR CONSTRAINT SATISFACTION
Giuseppina Gini and Carlo Rogialli Feb. 1991 22 p Sponsored in part by CNR
(Rept-91-010; ETN-91-99523) Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

It is well known that programming by constraints is a powerful way of expressing problems, unfortunately it is not always an efficient way of solving them. Problems that can be defined as Contraints Satisfaction Problems (CSP) are in planning, scheduling, image interpretation, temporal reasoning, and more. Constraint propagation plays an important role also in TMS and in qualitative physics. While the first examples of constraint satisfaction techniques in artificial intelligence have appeared since the seventies, it has been recognized that constraints can be the basis of programming languages. Work aimed at integrating CSP and the LISP environment as a general purpose tool is presented. A model of constraint satisfaction and a language are defined. The language implementation is discussed with particular emphasis on the debugging facilities and their use to monitor the domains of the variables. ESA

N91-30775 Politecnico di Milano (Italy). Dipt. di Elettronica.
SETS AND CONSTRAINTS IN AN OBJECT-ORIENTED DATA MODEL
Herman Balsters, Rolf deBy (Universiteit Twente, Enschede, Netherlands), and Roberto Zicari 1991 27 p Sponsored in part by EEC
(Rept-91-11; ETN-91-99524) Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

The object oriented data model TM is a language that is based on the formal theory of FM, a typed language with object oriented features such as attributes and methods in the presence of

subtyping. The general (typed) set constructs of FM allow (database) constraints in TM to be dealt with. The theory of FM is described and the role that set expressions may play in conceptual data base schemas is discussed. Special attention is paid to the treatment of constraints, and a three step specification approach is proposed. ESA

N91-30776*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
XSPEC: AN X RAY SPECTRAL FITTING PACKAGE. VERSION 2 OF THE USER'S GUIDE
R. A. Shafer, F. Haberl, K. A. Arnaud, A. F. Tennant (National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.), and Chris Barron, ed. Feb. 1991 128 p
(NASA-TM-105007; NAS 1.15:105007; ESA-TM-09; ISBN-92-9092-193-5; ISSN-1013-7076; ETN-91-99532)
Copyright Avail: NTIS HC/MF A07; EPD, ESTEC, Noordwijk, Netherlands, HC 40 Dutch guilders CSCL 09B

The user guide for XSPEC, a command driven, interactive, X-ray spectral fitting program is presented. It is designed to be completely detector independent so it can be used for any X-ray spectral instrument. An overview of the program commands and a walk through of an XSPEC session is presented. Individual commands and descriptions of the spectral models are given. For the more experienced user details of some of the programs associated with XSPEC, the command parser, and the addition of models to XSPEC are included. The PLT plotting package used by XSPEC is described together with the maximum likelihood option for users possessing X-ray spectra with small numbers of counts per bin. Details on the various files used by XSPEC and on the general file structure are also given. ESA

N91-30777# Leiden Univ. (Netherlands). Dept. of Applied Mathematics.
ON FINDING OPTIMAL POLICIES FOR MARKOV DECISION CHAINS: A UNIFYING FRAMEWORK FOR MEAN-VARIANCE-TRADEOFFS
Ying Huang and L. C. M. Kallenberg 1990 19 p
(TW-90-10; ETN-91-99552) Avail: NTIS HC/MF A03

The existence of optimal policies for maximum one period mean to standard deviation ratio, negative variance with bounded mean, and mean penalized by variance, Markov decision chains are proved constructively by reducing them to a related mathematical program. This program entails maximizing (xB/D(xb)) + C(xb) over x in a polytope and with given bounds on xb where C and D are convex and either D is constant or D is positive and nondecreasing, C is nondecreasing and xb is nonpositive. This program is in turn reduced to maximizing x(B + theta b) over x in the polytope parametrically in theta. Along the way, under the nonnegative initial distribution assumption, the rule of constructing a stationary maximum average reward policy from an extreme optimal solution of the associated linear program is generalized. Formulations and existence results for problems discussed by White (1987), Filar and Lee (1985), Sobel (1985), Kawai (1987) and Filar. Kallenberg and Lee (1989) are unified and extended and an effective computational procedure to solve them that is related to a method used by Kawai (1987) in a special case are given. ESA

N91-30778# Amsterdam Univ. (Netherlands). Dept. of Mathematics and Computer Science.
A FUNCTIONAL PARTIAL SEMANTICS FOR INTENSIONAL LOGIC
Serge Lapierre Sep. 1990 37 p Sponsored in part by Council of Canada Social Sciences and Humanities Research
(ITLI-LP-90-12; ISSN-0924-2082; ETN-91-99564) Avail: NTIS HC/MF A03

A partial semantics for the higher order modal language of intensional logic is suggested. Partial semantic values of functional types are defined as monotonic functions on partially ordered sets; it is shown that this characterization is materially adequate for representing partial values and that it overcomes the difficulties which arise in the attempt to introduce one place partial functions in the hierarchy of types. Partial semantic values of any type are related to classical semantic values of the same type by the mean of a relation of approximation. This allows a comparison of partial models with classical models. Classical semantics then appears to be a part of the partial semantics to the extent that there exists a bijective mapping from classical models onto totally defined partial models. This also allows, a notion of entailment which is coextensive with the classical notion to be defined, relatively to the partial semantics. ESA

N91-30779# Amsterdam Univ. (Netherlands). Dept. of Mathematics and Computer Science.
LOGICS FOR BELIEF DEPENDENCE
Zhisheng Huang Oct. 1990 23 p
(ITLI-LP-90-13; ISSN-0924-2082; ETN-91-99565) Avail: NTIS HC/MF A03

The theoretical foundations of belief dependence in multiple agent environment, where agents may rely on someone else about their beliefs of knowledge are investigated. Several logics for belief dependence are introduced and studied. An attempt is made to formalize the problem of belief dependence in the framework of general epistemic logics, by which it is argued that general epistemic logic is not appropriate to formalize the problem of belief dependence. Based on an approach which is similar to Fagin and Halpern's general awaraness logic, the second logic for belief dependence, called a syntactic approach, is presented. The third logic is an adapted possible world logic, where sub-beliefs are directly introduced in the models. ESA

N91-30780# Amsterdam Univ. (Netherlands). Dept. of Philosophy.
TWO THEORIES OF DYNAMIC SEMANTICS
Jeroen Groenendijk and Martin Stokhof Oct. 1990 15 p Submitted for publication
(ITLI-LP-90-14; ISSN-0924-2082; ETN-91-99566) Avail: NTIS HC/MF A03

The dynamic view on the semantics of the natural language, though stemming already from the seventies, developed into a widely studied subject in the second half of the eighties. At present, the unification of various dynamic theories constitues an important issue. Two theories are compared, update semantics and dynamic predicate logic. A general characterization of the idea of a dynamic semantics for natural language is given which subsumes these two theories. Short expositions of each of them are given and a comparison is made. ESA

N91-30781# Amsterdam Univ. (Netherlands). Dept. of Mathematics and Computer Science.
THE MODAL LOGIC OF INEQUALITY
Maarten deRijke Nov. 1990 22 p Revised Sponsored by Netherlands Organization for Scientific Research
(ITLI-LP-90-15; X-89-05; ISSN-0924-2082; ETN-91-99567) Avail: NTIS HC/MF A03

Some modal languages with a modal operator D whose semantics is based on the relation of inequality are considered. Basic logical properties such as definability, expressive power and completeness are studied. Some connections with a number of the other recent proposals to extend the standard modal language are pointed out. ESA

N91-30782# Amsterdam Univ. (Netherlands). Dept. of Philosophy.
UNIQUE NORMAL FORMS FOR COMBINATORY LOGIC WITH PARALLEL CONDITIONAL, A CASE STUDY IN CONDITIONAL REWRITING
Roel deVrijer (Vrije Univ., Amsterdam, Netherlands) Dec. 1990 15 p
(ITLI-CT-90-09; ISSN-0924-8374; ETN-91-99570) Avail: NTIS HC/MF A03

A simple proof of unicity of normal forms property for combinatory logic extended with parallel conditional, that is, with constants C, T and F (Conditional, True, False) and extra reduction

rules CTxy to x, CFxy to y and Czxx to x, is presented. The proof makes use of a method involving conditional term rewriting systems that has a more general application. The method is described and some other applications are discussed. ESA

N91-30783# Technische Univ., Eindhoven (Netherlands). Faculty of Electrical Engineering.
DESIGNING DEBUGGING TOOLS FOR SIMPLEXYS EXPERT SYSTEMS M.S. Thesis
E. H. J. Philippens Jan. 1990 61 p
(EUT-90-E-234; ISBN-90-6144-234-5; ISSN-0167-9708; ETN-91-99617) Avail: NTIS HC/MF A04

As a result of the increasing success in large scale integration techniques, rule-based expert systems have entered the application area of personal computer systems. In connection with the research concerning Simplexys, a toolbox enabling the realization of real time expert systems, some debugging tools were developed. These debugging tools consist of a tracer which makes it possible to 'trace' through the whole inferencing process, and an explain facility for examining the evaluation structure of the process. With the help of these tools, the users, usually knowledge engineers, can control and debug their rulebases or can prove the correctness and efficiency to experts in the domain problem field. The final implementation is working and has already been used to examine existing Simplexys expert systems. ESA

N91-30784# Technische Univ., Eindhoven (Netherlands). Faculty of Electrical Engineering.
THE USE OF PETRI NET THEORY FOR SIMPLEXYS EXPERT SYSTEMS PROTOCOL CHECKING Thesis Final Report
J. O. Lammers Jun. 1990 89 p
(EUT-90-E-238; ISBN-90-6144-238-9; ISSN-0167-9708; ETN-91-99618) Avail: NTIS HC/MF A05

The Simplexys real time expert systems toolbox allows the design of expert systems that are so compact and efficient that they allow real time operation even on a small computer such as a personal computer. Simplexys expert systems are also reliable, because the logical correctness and consistency of the knowledge base is checked using a variety of techniques. Due to this knowledge checking before the final expert system is built, little checking is necessary at run time. A Simplexys knowledge base contains a protocol that describes the time sequencing knowledge that is part of the knowledge base. This protocol closely resembles a Petri net. Petri net theory is used to realize an algorithm that checks the correctness of protocols. ESA

N91-30785# National Aerospace Lab., Amsterdam (Netherlands). Informatics Div.
VALIDATION OF DIGITAL SIMULATION METHODS IN CAE
M. A. M. Somers and J. vdVooren 10 Feb. 1989 32 p Presented at Conference on Computer Applications in Production and Engineering, Amsterdam, Netherlands, 9-11 May 1991
(NLR-TP-89026-U; ETN-91-99633) Avail: NTIS HC/MF A03

The validation of digital simulation methods in CAE (Computer Aided Engineering) is discussed in general terms, independent of specific areas of application or technical disciplines. Validation is considered as making an assessment of the physical relevance and the accuracy of the method involved through carefully controlled comparisons with results of other digital as well as physical simulation methods. This requires, in general, full understanding of all sources of discrepancies between the methods used in the comparison, and physical reality. Emphasis is placed on the informatics aspects of validation. This concerns the point of view that validation is to be considered a crucial, integral step in the development cycle of digital simulation methods, if these are to be given to the end user in the form of complete information systems. Attention is given to the policy and to the infrastructure required for the (internationally) competitive in house development of todays complex and highly sophisticated digital simulation methods, and to how this reflects on the validation process. Appropriate examples from computational aerodynamics are given throughout. ESA

N91-30786# National Aerospace Lab., Amsterdam (Netherlands). Informatics Div.
METHOD MANAGEMENT FOR THE BENEFIT OF LARGE SOFTWARE PACKAGES FOR ANALYSIS IN CAE
J. J. Schuurman, J. H. Meelker, and A. Kassies 23 Jan. 1989 19 p Presented at Conference on Computer Applications in Production and Engineering, Amsterdam, Netherlands, 9-11 May 1989 Sponsored in part by Dutch Ministries of Education and Sciences, and Dutch Ministry of Transport and Public Work
(NLR-TP-89027-U; ETN-91-99634) Avail: NTIS HC/MF A03

The application of MEBAS, a Method Base System designed to support the type of management of software components mentioned below, is illustrated for a large software package for flow analysis. The design and development of information systems for digital simulation in Computer Aided Engineering (CAE) is a continuous activity, following the development of mathematical models and numerical techniques. The resulting incremental development of information systems poses stringent requirements on the management of software configurations. In addition to the traditional management of source code in program libraries, it was proved to be necessary to manage software components in terms of their function, their implementation, and their relation to other software components. In this way, software components can be used consistently in different configurations. ESA

N91-30787# National Aerospace Lab., Amsterdam (Netherlands). Informatics Div.
DATA MANAGEMENT FOR SIMULATIONS IN CAE
F. J. Heerema and H. Steenbergen 23 Jan. 1989 20 p Presented at Conference on Computer Applications in Production and Engineering, Amsterdam, Netherlands, 9-11 May 1990
(NLR-TP-89028-U; ETN-91-99635) Avail: NTIS HC/MF A03

Analysis of the properties of complex industrial products (e.g. cars, ships, aircraft) is performed by means of digital and physical simulations. Requirements are imposed on facilities for management and usage of vast amounts of data. Not all requirements are met to a satisfactory level by the current database management technology. As a consequence specific data management solutions are applied in different situations, characterized by different properties of the various processes and of the internal structure of the data. A classification of the requirements and the related data management solutions is presented. The solution chosen implies a data management system in which both a database manager and a standard record handler are integrated. Examples are given in the area of aircraft flow simulation. ESA

N91-30788# National Aerospace Lab., Amsterdam (Netherlands). Informatics Div.
APPLICATION OF THE PROMISE PACKAGE FOR SIMULATION OF DISCRETE SYSTEMS
M. P. J. Cornelissen and G. Wedzinga 19 Jul. 1988 9 p Presented at 1988 USER 1 Conference, Ostend, Belgium, 6-8 Sep. 1988
(NLR-MP-88048-U; ETN-91-99651) Avail: NTIS HC/MF A02

The cost effectiveness of many industrial engineering activities can be improved considerably when use is made of digital simulations methods. The kernel of such methods is a mathematical model that describes the aspects that have to be simulated. The generalized simulation package PROMISE (PRocess Oriented Machine Independent Simulation Environment) was developed for digital simulation. The basic concepts of PROMISE are presented. It is shown that PROMISE can be used to study a wide variety of systems by presenting some of the operational studies where PROMISE is being used: analysis of the effect of sloshing fluids on spacecraft behavior; conceptual studies for satellite navigation systems; performance studies of data communication networks. ESA

N91-30789# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
THE TERM PROCESSOR KIMWITU: A SYSTEM FOR GENERATING LANGUAGE-BASED SOFTWARE

Peter vanEijk, Axel Belifante, and Henk Eertink Nov. 1990 12 p
(Memo-INF-90-70; ISSN-0923-1714; ETN-91-99662) Avail: NTIS HC/MF A03

A new system to support the construction of language based software is described. Its major innovation is open multiparadigm programming. This allows such software to be described in an arbitrary variety of styles, and also facilities tool integration. A large application is discussed. ESA

N91-30790# Universiteit Twente, Enschede (Netherlands). Tele-Informatics and Open Systems Group.
SELECTION STRUCTURES
Arend Rensink 11 Dec. 1990 34 p
(Memo-INF-90-71; ISSN-0923-1714; ETN-91-99663) Avail: NTIS HC/MF A03

Selection structures, a class of models akin to event structures are introduced and discussed. The main novel feature of selection structures is the treatment of 'conflicting behavior', which is not as usually modeled by a binary conflict relation, but more explicity by a set of 'selections'. The resulting model is more expressive than even flow event structures, but also easier to handle. In fact the issue of complete but non maximal sets of events as described by Van Glabbeek is avoided. Selection structures are used as a model for basic LOTOS, a powerful algebraic formalism. In this, results by others are improved in that operations over selection structures are simple and moreover constructive. The semantic equivalence that is induced by selection structures respects concurrency (that is, it does not validate the interleaving law) and respects nondeterminism. With respect to nondeterminism the equivalence is too strong, not validating for instance the idempotence of choice. ESA

N91-30791# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
OPERATIONAL SEMANTICS FOR PATH EXPRESSIONS WITH POSTPONING OF NONDETERMINISTIC CHOICES
J. J. Luursema Dec. 1990 26 p
(Memo-INF-90-72; ISSN-0923-1714; ETN-91-99664) Avail: NTIS HC/MF A03

A version of the operational semantics of path expressions that is capable of dealing with so called internal nondeterminism is studied. It is shown that the algebraic properties of path expressions, like community and associativity, are improved with these semantics. A short description of two programs using path expressions is given. The first one to suggest some extensions on path expressions. The second program, a kind of path expression debugger, is used to test the value of the semantics proposed and to compare it with other versions of semantics. ESA

N91-30792# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
HIERARCHICAL MANAGEMENT OF DISTRIBUTED OBJECTS
E. G. Zondag Nov. 1990 23 p
(Memo-INF-90-73; ISSN-0923-1714; ETN-91-99665) Avail: NTIS HC/MF A03

The management of objects in an open, distributed system should be independent of system size, topology, and heterogeneity. A generic management approach is proposed, based on Operator Trees (OTs). An OT provides a uniform, hierarchical management scheme for a specific purpose and a specific region of a system. OTs may inherit other OTs for realizing their service. This is illustrated by a placer tree inheriting a finder tree. Issues of object orientedness are discussed. Objects (encapsulations of methods and attributes) appear inadequate to model low level implementation concerns. Instead 'items' are used as abstraction models for both low and high level entities. ESA

N91-30793# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
FORMALIZATION OF INHERITANCE OF METHODS IN AN OBJECT-ORIENTED DATA MODEL
Chris C. deVreeze Mar. 1991 21 p Sponsored in part by Netherlands Organization for Applied Scientific Research, TNO
(Memo-INF-90-76; ISSN-0923-1714; ETN-91-99667) Avail: NTIS HC/MF A03

Extensions of the well known type system of Cardelli could well serve as frameworks in which the fundamental problem pertaining to OODBs (Object Oriented Data Bases) are tackled. To that end, OODB concepts are first mapped to concepts of the type system (this mapping is rather straightforward); e.g., inheritance translates to subtyping. While inheritance of data is already well understood, the inheritance of methods, i.e., of update and retrieval operations on complex data, poses a known problem. A solution is offered. Each method defined in a class translates to a function (lambda term) within a so called environment in this type system. Such a term is in fact an instantiation of a term scheme, in which a type variable Delta is used. It is shown how inheritance of methods reduces to inheritance of term schemes from one environment to another. The resulting type system solves (one version of) the problem of inheritance of methods, in a context of multiple inheritance and static type checking. ESA

N91-30794# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
FROM BEHAVIOR TO SILICON USING VHDL AS AN INTERMEDIATE
E. Molenkamp Dec. 1990 13 p
(Memo-INF-90-79; ISSN-0923-1714; ETN-91-99670) Avail: NTIS HC/MF A03

A top down design approach for digital systems, especially focusing on the processor design is presented. Two facets of the design process are highlighted; how to design a digital system and how to use VHDL as a description language during the design process. The design methodology of Blaauw is adopted. For the first design steps VHDL is used as description language, and for the last design step the VHDL designer is used which creates a realization of a VHDL code. Since there is no unique way to describe each design step in VHDL, alternative descriptions are given for them. The design methodology and the use of VHDL during the design process is illustrated with a simple processor. ESA

N91-30795# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
OBJECT-ORIENTEDNESS: A SURVEY
E. G. Zondag Dec. 1990 50 p
(Memo-INF-90-81; ISSN-0923-1714; ETN-91-99672) Avail: NTIS HC/MF A03

A survey on object oriented modeling and object oriented development is presented. Topics in the modeling section relate to objectives (uniformity, abstraction, information hiding, modularity, reusability and extensibility, understandability), encapsulation (behavior, interface predicates, composition) inheritance (single and multiple inheritance, abstract and concrete classes, specialization and generalization, classlessness, pseudo variables), delegation (the 'self' problem, actors, classes versus prototypes, classes versus components) typing (binding, polymorphism, genericity, conformance, coercion, classes versus types), relations (semantics, interaction), and characteristics (concurrency, persistency, immutability, versioning, protection). Topics in the development section relate to objectives (quality and costs, top down and bottom up, prototypes, maintainability), development (life cycle models, subsystems, visibility, volatility, considerations, distributed development, other approaches), analysis (OOA aspects, OOA schemes, from analysis to design), design (OOD aspects, OOD schemes, integrated OOA-OOD approaches), evolution and modification (metrics, tuning, frameworks), and tools (libraries, repositories). ESA

N91-30796# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
TIME-DEPENDENT PROCESSES IN FUNCTIONAL LANGUAGES

D. H. Fijma 19 Dec. 1990 28 p
(Memo-INF-90-87; ISSN-0923-1714; ETN-91-99678) Avail: NTIS HC/MF A03

A real time system is a computer program in which time is an essential component of the results. Programming these systems in a functional language requires a way to describe time dependent functions. These are functions whose outcomes are dependent on the time information in their input data. This can be done by adding implicit or explicit time information to data. Several methods of doing this can be found in literature. These methods are discussed as instantiations of a more general model of timing. The methods and the model are considered too weak to give the complete semantics of a real time program. Because of the lack of a notion execution, the exact production time of a data value cannot be stated. This information is important, because it influences the results of another function that takes this value as input. ESA

N91-30797# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
SOFTWARE METRIC ANALYSERS BASED ON ATTRIBUTE GRAMMARS: THE METRIC OF HALSTEAD AND MCCABE FOR PASCAL AND MIRANDA PROGRAMS
Ronald M. R. Robbers Dec. 1990 53 p
(Memo-INF-90-88; ISSN-0923-1714; ETN-91-99679) Avail: NTIS HC/MF A04

Software metrics are used to characterize some essential features of software quantatively, so that classification, comparison and mathematical analysis can be performed. To use abstract metric specifications, a certain link between these specifications and the programming language must be defined. A link founded on attribute grammars is discussed. The Cornell synthesizer generator is used to convert these attribute grammars to executable tools. For this purpose, the attribute grammars must be specified in the synthesizer specification language. The tools generated by the Cornell Synthesizer Generator are called Software Metric Analyzers (SMAs). One of the conclusions is that SMAs can be very powerful, but it can be very hard to specify them. The theory of these subjects is discussed including a great deal of examples of (parts of) specifications of SMAs written in the Synthesizer Specification Language (SSL). The metrics of Halstead and McCabe are discussed for the programming languages PASCAL and MIRANDA. How to modify and to create specifications. ESA

N91-30798# Universiteit Twente, Enschede (Netherlands). Tele-Informatics and Open Systems Group.
FAULT INFECTION SIMULATION: A VARIANCE REDUCTION TECHNIQUE FOR SYSTEMS WITH RARE EVENTS
Aad P. A. vanMoorsel, Boudewijn R. Haverkort, and Ignas G. Niemegeers Jan. 1991 11 p Presented at the 2nd International Working Conference on Dependable Computing for Critical Applications, Tucson, AZ, 18-20 Feb. 1991 Submitted for publication
(Memo-INF-91-05; ISSN-0923-1714; ETN-91-99687) Avail: NTIS HC/MF A03

A new technique, called Fault Injection Simulation (FIS), is presented that is suited for deriving results for steady state measures in discrete event dynamic systems which are strongly influenced by rarely occurring events. The FIS is based on decomposition of the observations in those that are affected and those that are not affected by these events. If methods are available, FIS can be used as a (partly) analytical technique, else as a pure fast simulation technique. It is shown that under intuitively appealing assumptions FIS gives an unbiased estimator and a variance reduction. Furthermore, it is shown how to adjust FIS during the simulation to obtain maximum variance reduction. FIS is discussed in the context of rarely occurring failures in networks for real time applications. Comparisons with other fast simulation techniques are made and results of FIS for an M/M/1 queue with rarely occurring service breakdowns are included. ESA

N91-30799# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
ALGEBRAIC GRAPH REWRITING USING A SINGLE PUSHOUT
P. M. vandenBroek Jan. 1991 16 p
(Memo-INF-91-09; ISSN-0923-1714; ETN-91-99690) Avail: NTIS HC/MF A03

A study which shows how graph rewriting can be described with a single pushout in a suitable category of graphs is presented. The result is compared with the conventional approach which uses double pushouts. ESA

N91-30800# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
DESIGN AS SCIENCE INSTEAD OF ART
L. K. Alberts, P. M. Wognum, and N. J. I. Mars Feb. 1991 30 p
(Memo-INF-91-10; UT-KBS-91-02; ISSN-0923-1714; ETN-91-99691) Avail: NTIS HC/MF A03

The technical design process from conceptualization to physical realization as a synthesis process, based on predefined building blocks is described. These building blocks or modules are grouped together at different levels of abstraction and define the technology that can be used at a particular stage in the design process on the trajectory from initial system specification to physical realization. To this end, the concept of technology layers, based on work in very large scale integration design and methodical design in mechanical engineering, is introduced. The state of the art in the definition of building blocks for design in electrical and mechanical engineering and the use of a framework based on technology layers for the acquisition and structuring of design knowledge are discussed. Based on a framework of technology based layers with generic building blocks, a description of design as a synthesis process is given. A knowledge based approach to synthesis to tackle a number of intractability problems is proposed, and a classification of the synthesis knowledge within the context of the framework, are presented. ESA

N91-30801# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
A DIY DEMO FOR THE ROCHESTER CONNECTIONIST SIMULATOR
Marc F. J. Drossaers 1 Feb. 1991 16 p
(Memo-INF-91-12; ISSN-0923-1714; ETN-91-99693) Avail: NTIS HC/MF A03

A manual for a 'Do It Yourself' (DIY) demonstration of the Rochester connectionist simulator is presented. The manual itself is preceded by a description of the implemented perceptron network, the way it represents a parser for a very simple language, and the way it learns to parse sentences from a restricted number of examples. ESA

N91-30802# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
DESIGN OF THE LOTOSPHERE SYMBOLIC LOTOS SIMULATOR
Peter vanEijk and Henk Eertink 7 Feb. 1991 6 p Sponsored in part by EEC
(Memo-INF-91-13; ISSN-0923-1714; ETN-91-99694) Avail: NTIS HC/MF A02

A status report on the new LOTOS simulator that is being developed in the ESPRIT Lotosphere Project is presented. Its functionality, first experiments with its use, and the tool architecture and tool technology related to it are discussed. It should be noted that this tool is preliminary and not yet distributed. ESA

N91-30803# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
FDT-BASED PROTOCOL DESIGN
Marten vanSinderen and Luis Ferreira Pires 22 Jan. 1991 12 p
(Memo-INF-91-16; ISSN-0923-1714; ETN-91-99697) Avail: NTIS HC/MF A03

Design of complex distributed systems demands methodological

support. The use of Formal Description Techniques (FDT's) can improve the quality of designs through the exploitation of their mathematical basis. Formal specifications can be manipulated by software tools for simulation, transformation, verification, and testing. Tools are even more useful if they can be used to support a consistent set of design methods. The state of the art in protocol design is discussed using the standard FDT LOTOS, and protocol design methods which explore characteristics of protocols and their formal specifications are introduced. ESA

N91-30804# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
A CLASSIFICATION OF TRANSITIVE CLOSURE ALGORITHMS
H. J. Steenhagen, P. M. G. Apers, and H. M. Blanken Feb. 1991 10 p
(Memo-INF-91-18; ISSN-0923-1714; ETN-91-99699) Avail: NTIS HC/MF A02

In recent years efficient recursive query processing strategies have beeen a topic of major interest in the research field of deductive databases. An important subclass of recursive query processing strategies is the class of algorithms to compute the transitive closure of a relation. A classification of well known bottom up transitive closure algorithms is presented. The classification is based on simple mathematics. This class is shown to be usefully extendable. ESA

N91-30805# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
GENERALIZED ADAPTIVE SEARCH: ANALYSIS OF CODINGS AND EXTENSION TO PARSING
Mark deWeger Mar. 1991 34 p
(Memo-INF-91-23; ISSN-0923-1714; ETN-91-99703) Avail: NTIS HC/MF A03

Genetic algorithms as described by Holland (1975) have been used to solve many problems involving search. These algorithms were based on a bit string representation of points of the search space. Later, other representations have been used for adaptive search. A theoretical analysis of genetic algorithms to a new class of problems requiring a different representation, parsing, is described. ESA

N91-30806# Universiteit Twente, Enschede (Netherlands). Tele-Informatics and Open Systems Group.
PATTERN SETS
Arend Rensink 5 Apr. 1991 24 p
(Memo-INF-91-24; TIOS-91/008; ISSN-0923-1714; ETN-91-99704) Avail: NTIS HC/MF A03

Pattern sets, a class of models akin to event structures, respecting both concurrency and nondeterminism are discussed. It is shown how pattern sets can be used as a semantic model: operations over pattern sets such as synchronization are relatively easy to define; the class of pattern sets is a complete partial order over which these operations are continuous. A corresponding operational semantics is defined in terms of 'pomset transitions'. A set of rules is given that constituted a complete proof system for the transitions of constructable pattern sets. The rules themselves are quite intuitive. As a proof, a semantics for the ISO standard language LOTOS, which is shown to be compatible to the standard (interleaving) semantics for LOTOS, is defined. ESA

N91-30807# Universiteit Twente, Enschede (Netherlands). Tele-Informatics and Open Systems Group.
TOOLS FOR LOTOS, A LOTOSPHERE OVERVIEW
Peter vanEijk Mar. 1991 30 p
(Memo-INF-91-25; TIOS-91/007; ISSN-0923-1714; ETN-91-99705) Avail: NTIS HC/MF A03

LOTOS is a specification language, but it is not very useful without a design methodology that describes the process from initial specification construction to implementation. The tools to support such a design process are discussed. The language, method and tools are beginning to be used in realistic applications, but the research on them continues. The current state of the art, with an emphasis on the Lotosphere project because that is where most of the work is currently being conducted, is considered. Comments on a design and implementation strategy for tools are included. ESA

N91-30808# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
RECOGNITION METHODS FOR CONTEXT-FREE LANGUAGES
Rieks opdenAkker Apr. 1991 19 p
(Memo-INF-91-30; ISSN-0923-1714; ETN-91-99709) Avail: NTIS HC/MF A03

The best known methods for recognition and parsing of general context free languages are Earley's method and the CYK (Cocke, Younger and Kasami). A method that is a generalization of the CYK is introduced. The recognition algorithm based on this method can be obtained from the CYK algorithm by a simple reinterpretation of the constructors used in that algorithm. It is shown how the method is an instance of general recognition scheme, of which Earley's algorithm is also an instance. The recognition algorithm introduced, clearly shows the relation between the two classical recognition methods. The method is suitable for implementation on an array of processors. ESA

N91-30809# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
REPRESENTATION OF TIME IN MATHEMATICAL PROGRAMMING MODELING LANGUAGES
J. J. Bisschop and C. A. C. Kuip 4 Feb. 1991 16 p
(MEMO-933; ISSN-0169-2690; ETN-91-99731) Avail: NTIS HC/MF A03

Time staged mathematical programming models have a planning horizon that is divided into a sequence of consecutive time periods. For the modeling of this sequence of time periods the use of calendars is proposed as an additional set concept for mathematical programming modeling languages. A calendar is a set in the ordinal scale and can be used to automatically verify the proper time referencing in stock balances. When a calendar is also a set in the difference scale, then backward and forward time referencing can be stated with the explicit use of time units. For models with a rolling horizon, concise and flexible ways to specify the structure of calendars are presented. The aggregation of raw data into model parameter values is supported by linking calendars that represent different time scales. The influence of the proposed calendar concept on the human ability to understand, maintain, and verify models is analyzed throughout the paper on the basis of selected examples. ESA

62 COMPUTER SYSTEMS

Includes computer networks and special application computer systems.

N91-30810# Virginia Univ., Charlottesville. Dept. of Computer Science.
FALCON: A DISTRIBUTED SCHEDULER FOR MIMD ARCHITECTURES
A. S. Grimshaw and V. E. Vivas, Jr. (Lagoven S.A., Caracas, Venezuela) 1991 15 p Presented at the Symposium on Experiences With Distributed and Multiprocessor Systems, Atlanta, Mar. 1991
(Contract DE-FG05-88ER-25063)
(DE91-014343; CONF-9103181-1) Avail: NTIS HC/MF A03

This paper describes the Fully Automatic Load Coordinator for Networks (FALCON), the scheduler for the Mentat parallel processing system. The FALCON has a modular structure and is designed for systems that use a task scheduling mechanism. The FALCON is distributed, stable, supports system heterogeneities, and employs a sender-initiated adaptive load sharing policy with static task assignment. The FALCON is parameterizable and is implemented in Mentat, a working distributed system. We present the design and implementation of FALCON as well as a brief introduction to those features of the Mentat run-time system that

influence FALCON. Performance measures under different scheduler configurations are also presented and analyzed with respect to the system parameters. DOE

N91-30811# California Univ., Irvine.
REAL-TIME RECOGNITION OF MULTIPLE TARGETS Final Report, 1 Jul. 1988 - 31 Dec. 1990
Jack Sklansky 12 Apr. 1991 5 p
(Contract DAAL03-88-K-0117)
(AD-A238364; ARO-26194.16-MA-SDI) Avail: NTIS HC/MF A01 CSCL 17/11

The results are summarized of new techniques for high speed recognition of multiple targets. Devising means of automatically detecting and recognizing multiple targets led to new insights into automatic and semi-automatic feature selection, parallel computer architectures, training procedures, and robustness in the face of changing data environments. These insights contribute to the growth of the technology and mathematics of intelligent machines. GRA

N91-30812# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
NETWORK LAYER ROUTING [NETWERKLAAG ROUTERING]
A. Pras Dec. 1990 22 p In DUTCH
(Memo-INF-90-83; ISSN-0923-1714; ETN-91-99674) Avail: NTIS HC/MF A03

The ISO-OSI (International Organization for Standardization Open Systems Interconnection) routing standards are presented. Routers are systems transmitting user messages at network level (layer 3 of the ISO-OSI Reference Model). The theory of routing is explained: its purposes, administrative domains, and decomposition into three functional information bases and four processes. The connectionless ES-IS (End Systems-Interconnection System) as well as the connection oriented ES-IS protocols are presented. The infra and inter domain routing protocols are presented. ESA

N91-30813# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
THE INTERNAL ORGANIZATION OF THE NETWORK LAYER [DE INTERNE ORGANISATIE VAN DE NETWERKLAAG]
Jeroen Schot Dec. 1990 22 p In DUTCH
(Memo-INF-90-84; ISSN-0923-1714; ETN-91-99675) Avail: NTIS HC/MF A03

The function of the network layer in the OSI (Open Systems Interconnection) reference model is explained. The network layer provides a global (i.e., worldwise) data communication service to users of end systems. This service utilizes the services offered by individual subnetworks, providing independence of the geographical organization and the different characteristics of the underlying subnetworks. The necessity and principles of the structuring of the network layer are outlined. The application of the network layer is presented. ESA

N91-30814# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
THE TRANSPORT LAYER [DE TRANSPORTLAAG]
Jeroen vandeLagemaat Dec. 1990 23 p In DUTCH
(Memo-INF-90-85; ISSN-0923-1714; ETN-91-99676) Avail: NTIS HC/MF A03

The ISO-OSI (International Organization for Standardization-Open Systems Interconnection) transport layer standards are discussed. The transport layer (i.e., layer 4 of the OSI reference model) contains the functions of the OSI network dealing with an efficient use of transmission capacity for the realization of a reliable transfer of information between users. The emphasis is on the quality of this transfer. This transport service and protocol are described. The present developments of transport standards are outlined. ESA

N91-30815# Universiteit Twente, Enschede (Netherlands). Tele-Informatics and Open Systems.
CONFORMANCE TESTING [CONFORMITEITSTESTEN]
Jan Tretmans and Jeroen vandeLagemaat Dec. 1990 18 p In DUTCH
(Memo-INF-90-86; ETN-91-99677) Avail: NTIS HC/MF A03

The International Organization for Standardization (ISO) conformance testing standard is discussed. Conformance testing is a method to demonstrate that an implementation of a standard protocol is conformable to the standards. Conformance tests in the development process of protocols, the purposes of conformance testing, and their inherent limitations are outlined. The three phases of the process of conformance testing are presented. The status of the development of test series for standard protocols is described. ESA

N91-30816 Politecnico di Milano (Italy). Dipartimento di Elettronica.
CONSTRUCTING AN EXACT PARITY BASE IS IN RNC(SUP 2)
Giulia Galbiati and Francesco Maffioli 1991 14 p Sponsored in part by Italian Ministry of University and Scientific and Technological Research
(Rept-91-022; ETN-91-99768) Avail: Politecnico di Milano, Piazzo Leonardo da Vinci 32, 20133 Milan, Italy

The parallel complexity of two problems defined over a 0-1 weighted, represented matroid, subject to parity conditions, is discussed. The problems of the existence and of the construction of a parity base of preassigned weight (exact parity base for short) are considered. These problems have already been studied where sequential random pseudo-polynomial algorithms for their solutions, in the more general context of integral weights, are presented. It is shown that they lay in the complexity class RNC(sup 2) and, that they are solvable in quadratic logarithmic time by randomized one sided error parallel algorithms that use a polynomially bounded number of processors. Some special cases of these problems of independent interest are discussed. The problem of the construction of a perfect matching of preassigned weight in a 0-1 weighted graph, or of a base of preassigned weight, in the intersection of two 0-1 weighted represented matroids is studied. The more general cases of all these problems over matroids or graphs weighted with integral instead of 0-1 weights, turn out to belong to the same parallel complexity class, as long as the weights are given in unary notation. ESA

N91-30817 Politecnico di Milano (Italy). Dipartimento di Elettronica.
STABILIZATION OF WORKLOAD DISTRIBUTION IN SOFT REAL-TIME DISTRIBUTED SYSTEMS
Vincenzo Caglioti Apr. 1991 20 p
(Rept-91-024; ETN-91-99770) Avail: Politecnico di Milano, Piazzo Leonardo da Vinci 32, 20133 Milan, Italy

Some unstable behavior of workload distribution algorithms, arising in soft real time distributed systems, are considered with respect to system dependability. The proposed approach first analyzes the system's behavior by formally proving some properties of the algorithms themselves, and then proposes a workload distribution algorithm which prevents such unstable behavior. The mutual influence between resource failures and overloads under soft real time contraints is analyzed. The distributed computer system is modeled as a set of resources including processors, communication lines and data items. ESA

N91-30818# Institut National Polytechnique, Grenoble (France). Lab. de Modelisation et Calcul.
PROGRAMMING OF MASSIVELY PARALLEL COMPUTERS. APPLICATIONS TO INTEGER FACTORING Ph.D. Thesis [PROGRAMMATION DES CALCULATEURS MASSIVEMENT PARALLELES. APPLICATION A LA FACTORISATION D'ENTIERS]
Jean-Laurent Philippe 1990 214 p In FRENCH; ENGLISH summary
(ETN-91-99482) Avail: NTIS HC/MF A10

Data allocation strategies on the processors are analyzed for the sieve of Eratosthenes in a shared memory environment in order to improve the workload balance. Implementations are proposed on the FPST 40 distributed memory hypercube. As the

sieve of Eratosthenes is not adapted to a distributed architecture, a new algorithm for generating primes through sequential divisions on a ring is studied. The processors which have terminated their computation are counted. Methodologies are derived for implementing master/slaves applications on a linear array and grid of processors. The multiple polynomial quadratic sieve is presented. It is an algorithm for factoring large integers which is used in cryptography. The aim is to extract the parallelism from each step of this algorithm in a distributed environment, in order to best use the available power of massively parallel computers. An efficient implementation is realized on the FPST40 hypercube. ESA

N91-30819# Institut National Polytechnique, Grenoble (France).
SEMANTICS OF PARALLELISM AND TEMPORAL LOGIC. APPLICATION TO FP2 LANGUAGE Ph.D. Thesis [SEMANTIQUE DU PARALLELISME ET LOGIQUE TEMPORELLE: APPLICATION AU LANGAGE FP2]
Philippe Schnoebelen 1990 170 p In FRENCH; ENGLISH summary
(ETN-91-99484) Avail: NTIS HC/MF A08

The links existing between operational models with behavioral equivalence and temporal logics are examined. Systems with infinite branching are considered. The classical adequacy results between operational models and temporal logics must be relativized. Bisimulation equivalence is strictly more powerful than equivalence induced by branching time logics. It is shown that temporal logic equivalence is not a congruence with regard to usual parallel program combinators and that the induced congruence is still weaker than bisimulation. A complete definition of FP2 language and its semantics is given. A new method is proposed for the automated verification of FP2 programs. This method is not restricted to finite state systems. It relies on the use of term rewrite rules as the basis of FP2 language and uses Comon's results on disunification. ESA

N91-30820# Institut National Polytechnique, Grenoble (France). Lab. de Genie Informatique.
CLEO: AN ERROR DIAGNOSIS METHOD IN XESAR Ph.D. Thesis [CLEO: DIAGNOSTIC DES ERREURS EN XESAR]
Anne Rasse 1990 170 p In FRENCH; ENGLISH summary
(ETN-91-99485) Avail: NTIS HC/MF A08

Error diagnosis methods for parallel communicating systems with branching temporal specifications are examined. It was motivated by the diagnosis of errors detected by XESAR, a tool for the verification of protocols described with a variant of Estelle language. From the program describing a protocol, XESAR generates a finite graph whose sequences represent the execution paths. The verification is the comparison of this graph with the specifications. When the specifications are not satisfied, a diagnosis must be provided, in order to explain the reasons for the error. CLEO is a prototype of an error diagnosis system which was integrated in XESAR. An order relation is defined in the diagnosis set. Diagnoses are produced in a simplified form, according to a set of visible actions. An equivalence is defined. Simplified diagnoses are computed in a reduced equivalent model. ESA

N91-30821 Politecnico di Milano (Italy). Dipartimento di Elettronica.
EFFICIENT USE OF THE 3N CODE FOR CONCURRENT ERROR DETECTION IN PARALLEL MULTIPLIERS
Vincenzo Piuri and Renato Stefanelli 1990 23 p
(Rept-90-044; ETN-91-99511) Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

The use of 3N code to implement efficient parallel multipliers with concurrent error detection capabilities at low cost in terms of silicon area and computation delay is discussed. The 3N coding technique is shown to be effective for different classes of multiplier: Braun's, Dadda's, and Wallace's multipliers. ESA

N91-30822 Politecnico di Milano (Italy). Dipartimento di Elettronica.
ALECSYS: A PARALLEL LABORATORY FOR LEARNING CLASSIFIER SYSTEMS
Marco Dorigo and Enrico Sirtori Feb. 1991 11 p Sponsored in part by CNR
(Rept-91-004; ETN-91-99517) Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

A major problem with learning classifier systems is how to tackle real world problems. A distinctive characteristic of many real world problems is that they present a complexity that cannot be user defined, and which is generally orders of magnitude higher than in toy systems. The use of more powerful parallel machines is a way to attack this problem from two sides: through an increase in the performance of standard algorithms, and by design of a new structural organization of the learning system (organization that should allow a better control on the environmental complexity). In order to explore the potentialities, a tool, ALECSYS, that can be used to implement parallel learning systems in a modular fashion is built. In ALECSYS parallelism is used both to increase the system performance, by low level parallelization, and to allow the use of many different learning classifier systems simultaneously, by high level parallelization. The system organization and the algorithms used are presented and some simulation results are reported. ESA

N91-30823# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
AN ALGORITHM FOR GENERATING NODE DISJOINT ROUTES IN KAUTZ DIGRAPHS
Gerard J. M. Smit, Paul J. M. Havinga, and Pierre G. Jansen Dec. 1990 26 p
(Memo-INF-90-43; ISSN-0923-1714; ETN-91-99660) Avail: NTIS HC/MF A03

A particular class of interconnection network for parallel systems, the Kautz networks are studied. These networks have interesting properties. For a Kautz network with degree d and N=d(sup k)+d(sup k-1) nodes (for any cardinal d, k greater than 0), the diameter is at most logarithm of N to the base d, the degree is fixed and independent of the network size. The network is fault tolerant and the connectivity is d. The mapping from standard computation graphs such as a linear array, a ring and a tree to a Kautz network is straightforward. The network allows for a simple routing algorithm, even when nodes or links are faulty. Imase et al., showed the existence of d node disjoint paths between any pair of vertices. An algorithm to find the d node disjoint routes between any two nodes in the network is presented. The routes are generated with increasing length and are free of loops. These routes are node disjoint and are as short as possible. As the performance of interprocessor communication is a key issue in parallel systems, a hardware implementation of this algorithm is shown to be straightforward. ESA

N91-30824# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
THE TRANSPUTER OPERATING SYSTEM TROS: REFERENCE MANUAL (TROS VERSION 0.6)
Wilco Oelen 21 Nov. 1990 136 p
(Memo-INF-90-68; ISSN-0923-1714; ETN-91-99661) Avail: NTIS HC/MF A07

The TRansputer Operating System (TROS) is a distributed multitasking operating system that runs on (a network of) transputers. The basis of this operating system is formed by a small conventional kernel which takes care of process creation and process scheduling and access to the links of the transputer. On top of this basic kernel a communication system has been written. This communication system has a layered structure similar to the OSI reference model. Each layer provides a communication service to the next layer. The highest layer provides a communication service to the user applications. This document is meant as a reference manual of the TROS system. It contains a short overall description of TROS, followed by a complete functional description of all of its modules. In an appendix the usage of TROS is explained by means of programming examples. ESA

N91-30825# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
A UNIFIED INTRODUCTION TO BASIC NEURAL NETWORKS
Marc F. J. Drossaers 17 Dec. 1990 57 p
(Memo-INF-90-80; ISSN-0923-1714; ETN-91-99671) Avail: NTIS HC/MF A04

An overview of a number of neural networks that might be considered paradigmatic examples in neurocomputing is presented. To give a clear view on the field, the various networks are presented, in a uniform notation, as parameter settings of a neural network template. Since the paper is introductory, attention is paid to a number of techniques that are commonly used in, among others, neurocomputing. Attention is also paid to the relation between computational characteristics and parameter choices. ESA

N91-30826# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
NETWORK MANAGEMENT: AN ALTERNATIVE VIEW
A. Pras Dec. 1990 11 p Presented at the 2nd International Symposium on Integrated Network Management, Washington, DC, 1-5 Apr. 1991
(Memo-INF-90-82; ISSN-0923-1714; ETN-91-99673) Avail: NTIS HC/MF A03

It is argued that network management should not be restricted to the operational phase of networks, but should also include the design phase. Only then is it possible to relieve the network manager. The nature of the design process is discussed and the relation between designing 'normal data' and 'management' protocols is addressed. The example of the OSI (Open System Interconnection) network layer is used to illustrate this relation. ESA

N91-30827# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
SYNCS AND REAL-TIME BEHAVIOUR OF THREADS
Pierre Jansen and Maurice L. M. Luttmer (Oce Nederland B.V., Venlo.) Jan. 1991 19 p
(Memo-INF-91-04; ISSN-0923-1714; ETN-91-99686) Avail: NTIS HC/MF A03

Part of a real time executive is described in which scheduling of threads was organized in such a way that threads with the highest effective priorities are served best. The effective priority of a thread is determined by its deadline and the deadlines of threads that are waiting for it. A new elementary synchronization primitive called a 'sync' is introduced. Syncs allow for clear semantics of priority of threads and are essential for fair scheduling of threads. The executive is used in Tumult 64, a closely coupled multiprocessor system. ESA

N91-30828# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
PARALLEL EXECUTION OF MULTI-JOIN QUERIES
Annita N. Wilschut and Peter M. G. Apers Feb. 1991 20 p
(Memo-INF-91-11; ISSN-0923-1714; ETN-91-99692) Avail: NTIS HC/MF A03

The performance and characteristics of the execution of various join trees on a parallel Data Base Management System (DBMS) are studied. The results of this study, are a step into the direction of the design of a query optimization strategy that is fit for parallel execution of complex queries. Among others, synchronization problems are identified to limit the performance gain from parallelism. A new hash join algorithm is introduced that has fewer synchronization constraints than the known hash join algorithms. Also, the synchronization between individual join operations in a join tree is studied in a stimulation experiment. The results show that the introduced pipelining hash join algorithm yields a better performance for multijoin queries. Also, the format of the optimal join tree appears to depend on the size of the operands of the join: a multijoin between small operands performs best with a bushy schedule; larger operands are better off with a linear schedule. The insight into the behavior of the parallel execution of multijoin queries that is gained can be used to design a new query optimization strategy. ESA

N91-30829# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
CONSISTENT ALTERNATIVES OF PARALLELISM WITH CONFLICTS: TWO PARTIAL ORDER SEMANTICS FOR SHARED VARIABLE CONCURRENCY
Wil Janssen, Mannes Poel, and Job Zwiers Mar. 1991 23 p
(Memo-INF-91-15; ISSN-0923-1714; ETN-91-99696) Avail: NTIS HC/MF A03

A simple algebraic process language is introduced for specification of actions and their causal dependencies, including shared variable parallelism and a 'conflict composition' operator replacing classical sequential composition. Two alternative models based on 'partial order semantics' are defined, one in the style of Pratt and one extending techniques developed by Barringer, Kuiper, and Pnueli. The two semantics are shown to be consistent. Atomic execution of the process is studied. It can be dealt with easily in one of the two models, relying on the capability to distinguish between process actions and environment actions. ESA

N91-30830# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
THE TUMULT MULTI-VERSION FILESYSTEM
G. C. H. Terlien and P. G. Jansen Apr. 1991 37 p
(Memo-INF-91-29; ISSN-0923-1714; ETN-91-99708) Avail: NTIS HC/MF A03

A distributed file system designed for a parallel multiprocessor computer is presented. In this system, multiversion control, garbage collection and caching are integrated. A user friendly interface is provided, which offers POSIX compatible filesystem calls. The filesystem is location transparent, and a file can be concurrently opened by multiple readers and one writer, without consistency conflicts. On opening a file, access is granted to the most actual version of the file. When a write action must be performed and the number of users of the most actual version of the time is more than one, a new version will be created. Datablocks of opened non actual versions of a file remain on disk as so called 'GarbageCandidates'. Closely connected to the multiversion scheme is a surprisingly simple garbage collection scheme that decides when GarbageCandidates can be released. Caching and multiversion control are integrated such that the validity of cached data can be checked locally without interaction with the server. The performance benefits of this method are clear: unlike many other distributed filesystems, it is not necessary to send explicit cache invalidation messages when a file is being updated by a writer. ESA

N91-30831# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
A SURVEY OF PARALLEL EXECUTION STRATEGIES FOR TRANSITIVE CLOSURE AND LOGIC PROGRAMS
Filippo Cacace, Stefano Ceri (Modena Univ., Italy), and Maurice A. W. Houtsma Dec. 1990 38 p Sponsored in part by CNR
(MEMO-923; ISSN-0169-2690; ETN-91-99724) Avail: NTIS HC/MF A03

Approaches to parallel execution of recursive queries presented in the literature are discussed. Research on parallel execution of recursive queries is separated into two distinct sub areas, one focused on the transitive closure of relational algebra expressions, the other one focused on datalog optimization. Though the sub areas seem radically different for the approach and formalism used, they have many features in common. The most typical datalog queries have exactly the same expressive power as transitive closure of simple algebraic expressions. Equivalence among solution methods developed in each sub area is established. A graphic formalism for describing parallel executions is presented. Algorithms developed in the frame of algebraic transitive closures which operate on entire relations are reviewed. Fragmentation is introduced, distinguishing between hash-based and semantic fragmentation. General datalog queries are considered. ESA

N91-30832# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
PARALLEL HIERARCHICAL EVALUATION OF TRANSITIVE CLOSURE QUERIES
Maurice A. W. Houtsma, Filippo Cacace (Modena Univ., Italy), and Stephano Ceri 20 Dec. 1990 20 p
(MEMO-924; ISSN-0169-2690; ETN-91-99725) Avail: NTIS HC/MF A03

A new approach to parallel computation of transitive closure queries which uses a semantic data fragmentation is discussed. Tuples of a large base relation are assumed to denote edges in a graph which models a transportation network. A fragmentation algorithm which produces the partitioning of the base relation into several fragments such that any fragment corresponds to a subgragh is proposed. Any two fragments are considered as either 'adjacent' or 'nonadjacent'; two fragments are adjacent when the corresponding subgraphs have a nonempty intersection. One fragment, called a 'high speed fragment', collects all edges which guarantee maximum speed, and correspond to highways or to high speed intercity trains. Thus, the fragmentation algorithm induces a hierarchical relationship between the high speed fragment and all other fragments. With this fragmentation, any query about paths connecting two nodes can be answered by using just the fragments in which nodes are located and the high speed fragment. In general, if each fragment is managed by a distinguished processor, then the query can be answered by three processors working in parallel. This scheme can be recursively applied to generate an arbitrary number of hierarchical levels. ESA

63 CYBERNETICS

Includes feedback and control theory, artificial intelligence, robotics and expert systems.

For related information see also *54 Man/System Technology and Life Support.*

N91-30833# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
INDEXING FOR VISUAL RECOGNITION FROM A LARGE MODEL BASE Memorandum Report
Thomas M. Breuel Aug. 1990 34 p
(Contracts DACA76-85-C-0010; N00014-85-K-0124)
(AD-A229320) Avail: NTIS HC/MF A03 CSCL 23/2

A new approach is described to the model base indexing stage of visual object recognition. Fast model base indexing of 3-D objects is achieved by accessing a data base of encoded 2-D views of the objects using a fast 2-D matching algorithm. The algorithm is specifically intended as a plausible solution for the problem of indexing into very large model bases that general purpose vision systems and robots will have to deal with in the future. Other properties that make the indexing algorithm attractive are that it can take advantage of most geometric and non-geometric properties of features without modification, and that it addresses the incremental model acquisition problems for 3-D objects. GRA

N91-30834# Analytics, Inc., Willow Grove, PA.
ARTIFICIAL INTELLIGENCE FOR COMMAND AND CONTROL
Robert J. Lysaght, Regina Harris, and William Kelly 15 May 1988 203 p
(Contract DAAB07-87-C-A034)
(AD-A229342) Avail: NTIS HC/MF A10 CSCL 12/5

The purpose of this research was to assess the feasibility of developing a decision aiding support system, through human factors engineering and decision making analysis, to support one of the Army Corps battlefield tasks - mobility, countermobility, and survivability as performed by combat engineers. Literature reviews were augmented by in depth analysis of the combat engineer's decision making activities. Combat engineers were interviewed. Based on these systematic analysis steps, a solution was found which applied cognitive science technologies to the traditional arts of decision analysis, emphasizing the use of interactive intelligence as a modality to improve the combat engineer's decision making with respect to developing plans for engineering operations. The Combat Engineer decision aiding system (CETOOLS) was designed to provide decision aiding support for combat engineer planning activities. The proposed design was judged feasible with a low level of risk. Author

N91-30835# Pennsylvania State Univ., University Park. Dept. of Computer Science.
A COMPLEXITY THEORY OF NEURAL NETWORKS Annual Technical Report, 15 Mar. 1989 - 14 Mar. 1990
Ian Parberry, Piotr Berman, and Georg Schnitger 14 Apr. 1990 15 p
(Grant AF-AFOSR-0400-87)
(AD-A229432; AFOSR-90-1121TR) Avail: NTIS HC/MF A03 CSCL 12/7

Significant results have been obtained on the computation complexity of analog neural networks, and distribute voting. The computing power and learning algorithms for limited precision analog neural networks have been investigated. Lower bounds for constant depth, polynomial size analog neural networks, and a limited version of discrete neural networks have been obtained. The work on distributed voting has important applications for distributed computation in the presence of faults, and the management of replicated databases. GRA

N91-30836# Nebraska Univ., Lincoln. Dept. of Mathematics and Statistics.
FEEDBACK CONTROL IN DISTRIBUTED PARAMETER SYSTEMS Final Report, 1 Aug. 1988 - 31 Jul. 1990
Richard Rebarber 27 Sep. 1990 5 p
(Grant AF-AFOSR-0230-88)
(AD-A229433; AFOSR-90-1120TR) Avail: NTIS HC/MF A01 CSCL 12/2

In this project questions related to stabilization of vibrating system by feedback were studied. A vibrating system is uniformly stabilized by a feedback if there is a uniform rate of decay for all vibrational modes of the closed-loop system, which is the system with feedback. Necessary conditions were found for certain kinds of feedback to uniformly stabilize a system which is originally undamped and has the feedback applied at the boundary. Sufficient conditions were found for the feedback to lead to a closed-loop system which is mathematically well-posed. It was also shown that in a large class of systems which are stabilized by feedback, if a small delay is introduced in the computation of the feedback, then the stability of the closed-loop system is destroyed. GRA

N91-30837# Army Armament Research, Development and Engineering Center, Picatinny Arsenal, NJ.
ARTIFICIAL NEURAL SYSTEM FOR OBJECT CLASSIFICATION AND ORIENTATION ESTIMATION
Timothy A. Grogan, Jeffrey D. Johnson (Grogan, Timothy A., Cincinnati, OH), and Frank Kuhl Apr. 1991 64 p
(AD-A234936; ARFSD-CR-91007) Avail: NTIS HC/MF A04 CSCL 12/9

The usefulness of self-organizing neural systems for the problems of object recognition and orientation estimation are discussed. Self-organizing neural systems, like unsupervised cluster algorithms from classical pattern recognition, are most useful when no predetermined labels are available to attach to input patterns which must be categorized by the system. However, this makes it necessary to assign a 'natural' category to the input stimuli from the environment. Only with some type of supervisory feedback will this natural category be associated with the proper label for the input pattern. Without this teaching input, the internal, self-organizing principles of the system must be used to assign categories. These assigned categories may or may not coincide with the unique labels of an external supervisory system. GRA

N91-30838# Defense Logistics Agency, Columbus, OH. Capacity Planning Branch.
ARTIFICIAL INTELLIGENCE INFORMATION SOURCES FOR

THE BEGINNER AND EXPERT Final Report
Mott Given May 1991 10 p
(AD-A236587) Avail: NTIS HC/MF A02 CSCL 12/9

A tremendous amount of information on artificial intelligence is available via different journals and organizations. But the beginner in AI may not know about many of the sources, while the expert may have difficulty finding the exact information wanted in the shortest time. The best sources of information for answering particular categories of recurring questions will be discussed. This paper will list around 200 journals, serials, and newsletters, and discuss special features of some of them. Indexes, literature guides, and bibliographies to the AI literature will be presented. A variety of AI professional organizations will be listed which facilitate keeping track of new developments. GRA

N91-30839 Arizona State Univ., Tempe.
PLANNING AND DISTRIBUTED PLANNING BASED ON OBJECTS AND RELATIONS WITH GOAL-DIRECTED DYNAMIC PLAN REVISION Ph.D. Thesis
Qing Ge 1990 266 p
Avail: Univ. Microfilms Order No. DA9116741

Three areas in the field of artificial intelligence are discussed; planning in general, distributed planning and problem solving, and dynamic plan revision. One of the most important and difficult problems in planning is to determine the effects of an action taken in the world. A new approach for reasoning about action is introduced, which is supported by the concepts of objects and relations. This approach makes use of the way human beings view the world, facilitates world modelling and enables the system to determine the effects of actions. Distributed planning and problem solving is a new and promising research area. An analysis on the cooperation at different phases of distributed problem solving processes is conducted. Two new issues were identified and studied: the timing problem and the network perception problem both of which contribute to coherent network behavior. The perceive-plan-act loop was introduced. The coordination between nodes was improved and global coherence enhanced. A system, based on the research results obtained, was designed and implemented. The domain of Distributed Manufacturing Operations was chosen as the testing environment, and experimental results were shown. Dissert. Abstr.

N91-30840 Illinois Univ., Chicago.
A PREDICATE/TRANSITION NET MODEL FOR ARTIFICIAL INTELLIGENCE ROBOT PLANNING Ph.D. Thesis
Jaegeol Yim 1990 119 p
Avail: Univ. Microfilms Order No. DA9115030

A place/transition net model for propositional logic rule based systems is examined. Inputs and outputs of a real time control system are in general binary information. Inputs are 0 to 1 values from sensors, and outputs are 0 to 1 values to enable or disable actuators. For this application domain, propositional logic is a natural method of representing a problem specification. A propositional logic program can be easily modelled in a place/transition net. The place/transition net fixpoint method is proposed for real time control system design. Test results show that the algorithm is very efficient. The predicate/transition (pr/t) net method for artificial intelligence robot planning problems is also considered. An algorithm is presented for automatic construction or a pr/t net model for a robot planning problem. Then by analyzing the net model, a solution can be found for the planning problem. Also, a bidirectional means-end analysis technique is proposed for the pr/t model for the planning problem. Conventional bidirectional search strategies are valid under the assumption that the goal is fully described. The bidirectional search technique proposed can handle a partially described goal. Dissert. Abstr.

N91-30841# Air Force Flight Dynamics Lab., Wright-Patterson AFB, OH.
URV MULTIPROCESSOR CONTROL SYSTEM AND GROUND STATION CONTROLLER SOFTWARE DESIGN Final Report, Aug. - Oct. 1990
Michael S. Rottman, Thomas F. Dermis, and Amy R. Hartfield May 1991 57 p
(AF Proj. 2403)
(AD-A237532; WL-TR-91-3015) Avail: NTIS HC/MF A04 CSCL 12/5

The design and implementation of the core controller software is documented for the Multiprocessor Control System (MCS) and Ground Station Core (GSC) for the new Lambda and Gamma Unmanned Research Vehicle (URV) aircraft. Included are the high level design issues and goals; a description of the real time multiprocessor operating system (RTMOS) being used; and a complete discussion of the software objects needed for both the MCS and GSC. GRA

N91-30842# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
GRAPHIC INTERFACE FOR STRUCTURED ENVIRONMENT VISUALIZATION AS APPLIED TO ROBOT CONTROL [INTERFACE GRAFICA PARA VISUALIZACAO DE AMBIENTES ESTRUTURADOS PARA APLICACAO NA NAVEGACAO DE ROBOS]
Alexandre GuirlandNowosad Apr. 1991 28 p In PORTUGUESE; ENGLISH summary
(INPE-5231-RPE/646) Avail: NTIS HC/MF A03

The use and main features are explained of an applicative computer program for structured environment visualization. The program was written using C language and developed in a PC compatible environment. Author

N91-30843# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
APPLICATION OF GESTALT THEORY CONCEPTS FOR IMAGE INTERPRETATION FOR ROBOT MOVEMENT NAVIGATION M.S. Thesis - 14 Feb. 1990 [UMA APLICACAO DE CONCEITOS DA TEORIA DE GESTALT NA INTERPRETACAO DE IMAGENS PARA A NAVEGACAO DE ROBOS MOVEIS]
Eunice Kinuyo Odashima Mar. 1991 144 p In PORTUGUESE; ENGLISH summary
(INPE-5225-TDL/438) Avail: NTIS HC/MF A07

Research involved the development of machine vision for a vehicle capable of moving from one place to another while employing collision avoidance capabilities. The specific objective of the study was the use of image segmentation of the interior space and the obstacles therein to construct a cognitive map of the robot's movements. The paradigm is based on Gestalt psychology and geometry. Author

N91-30844# Loughborough Univ. of Technology (England). Dept. of Mathematical Sciences.
POLE ASSIGNMENT BY OUTPUT FEEDBACK: A REVIEW
Myungho Oh Jan. 1991 58 p
(MATHS-Rept-A-142; ETN-91-99780) Avail: NTIS HC/MF A04

Some of the existing algorithms for pole assignment by output feedback control are reviewed and compared for a selection of test problems. Some possible modifications and the required research direction of a new algorithm are suggested. It is concluded that the Minimis algorithm assigns poles sufficiently close to those desired provided no two poles are too close to each other. The Nichols et al algorithm does not have restrictions on the dimension of system matrices. It provided good conditioning but it is not always possible to assign the poles sufficiently close to those desired. Development of an algorithm incorporating the ideas of both the algorithms is suggested. This new algorithm could be tested by considering the design of controllers for a generic vertical takeoff and landing aircraft. A nonlinear model of the aircraft which will enable a realistic assessment to be performed is available. ESA

N91-30845 British Aerospace Public Ltd. Co., Preston (England). Software Technology Dept.
DEVELOPMENT METHODOLOGIES FOR KNOWLEDGE BASED SYSTEMS: A COMPARATIVE REVIEW
M. R. Bateman 6 Dec. 1990 47 p

(BAe-WIT-RP-GEN-SWE-1996; ETN-91-99837) Copyright Avail: British Aerospace (Military Aircraft) Ltd., Warton Aerodrome, Preston, Lancashire, PR4 1 AX, England

A number of Knowledge Based Systems (KBS) development methodologies are described and evaluated. The majority of methodologies reviewed are somewhat superficial and as a consequence do not receive extensive consideration. Three methodologies, namely KADS, Syntel and Alpha/DS are given a more comprehensive discussion. KADS is given particular attention. It is recommended that KADS be further evaluated to determine its suitability for real time and closly coupled conventional and KBS applications. ESA

N91-30846# Sheffield Univ. (England). Dept. of Control Engineering.
PROPERTIES OF NEURAL NETWORKS WITH APPLICATION TO MODELLING NONLINEAR DYNAMICAL SYSTEMS
S. A. Billings, H. B. Jamaluddin, and S. Chen (Edinburgh Univ., Scotland) Mar. 1991 55 p Sponsored in part by Science Research Council
(RR-418; ETN-91-99464) Avail: NTIS HC/MF A04

Properties of neural network performance are investigated by studying the modeling of nonlinear dynamical systems. Network complexity, node selection, prediction and the effects of noise are studied and some new metrics of performance are introduced. The results are illustrated with both simulated and industrial examples. ESA

N91-30847 Politecnico di Milano (Italy). Dipt. di Elettronica.
ON THE OUTPUT CONTROL OF MULTIRATE SYSTEMS SUBJECT TO ARBITRARY EXOGENOUS SIGNALS
Riccardo Scattolini and Nicola Schiavoni 1991 24 p Sponsored in part by Italian Ministry of University and Scientific Research
(Rept-91-006; ETN-91-99519) Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

The design of MIMO digital control systems characterized by a non standard sampling mechanism is considered. Specifically, a solution to the output robust control problem in the general case, where the exogenous signals coincide with the free motion of an unstable system, is given. ESA

N91-30848# Amsterdam Univ. (Netherlands). Dept. of Mathematics and Computer Science.
AWARENESS, NEGATION AND LOGICAL OMNISCIENCE
Zhisheng Huang and Karen Kwast Dec. 1990 22 p
(ITLI-LP-90-16; ISSN-0924-2082; ETN-91-99568) Avail: NTIS HC/MF A03

General epistemic logics suffer from the problem of logical omniscience, which is that an agent's knowledge and beliefs are closed under implication. There have been many attempts to solve the problems of logical omniscience. However, sometimes an agent's knowledge and beliefs are indeed closed under implication. Based on the notion of awaraness, two kinds of negations, general negation and strong negation' are introduced. Moreover, four kinds of implications, general implication, strong implication, weak implication, and semi strong implication, are introduced to correspond with the two kinds of negations. In our logics of regular awareness, explicit beliefs are not necessarily closed under general implication, which means that agents are not logically omniscient. However, explicit beliefs are closed under strong implication and semi strong implications, which captures an intuitive closure property of beliefs. ESA

N91-30849# Technische Univ., Eindhoven (Netherlands). Faculty of Electrical Engineering.
KNOWLEDGE BASE CORRECTNESS CHECKING FOR SIMPLEXYS EXPERT SYSTEMS M.S. Thesis
J. M. A. Lutgens May 1990 64 p
(EUT-90-E-240; ISBN-90-6144-240-0; ISSN-0167-9708; ETN-91-99620) Avail: NTIS HC/MF A04

As a result of the rapid development in computer science, rule based expert systems have entered the application of personal computer systems. In connection with the research concerning Simplexys, a toolbox enabling the realization of real time expert systems, some debugging tools were developed for proving the correctness of the knowledge base. One of these debugging tools, the semantic checker, was completely revised, resulting in a checker which is capable of systematically checking the rule base for logical completeness and consistency. This is done by using a method, which is mathematically sound and generally applicable. ESA

N91-30850# Technische Univ., Eindhoven (Netherlands). Measurement and Control Group.
A COMPARISON OF CLASSICAL AND MODERN CONTROLLER DESIGN: A CASE STUDY
Martin Klompstra, Ton vandenBoom, and Ad Damen Nov. 1990 53 p
(EUT-90-E-244; ISBN-90-6144-244-3; ISSN-0167-9708; ETN-91-99624) Avail: NTIS HC/MF A04

Four different types of controllers for a SISO servotracking process are designed and compared with each other. The dynamics of the process are globally described by a first order process cascaded with a triple integrator. Both the classical control theory and the more recently developed H(infinity)/H(2) control theory are used for the design of the controllers. Care was taken to ensure that the various designs were made independently. Special attention was paid to the triple integrating behavior of the process and to possible saturation of the actuator. The comparison of the controllers is done in the time domain (e.g. tracking), as well as in the frequency domain (e.g. robust stability). The performance of the conctrollers is illustrated by simulations and experiments with the process under study. ESA

N91-30851# Technische Univ., Eindhoven (Netherlands). Group Digital Systems.
DECOMPOSITIONAL STATE ASSIGNMENT WITH REUSE OF STANDARD DESIGNS: USING COUNTERS AS SUB-MACHINES AND USING THE METHOD OF MAXIMAL ADJACENCIES TO SELECT THE STATE CHAINS AND THE STATE CODES
Lech Jozwiak and T. Spassova-Kwaaitaal Sep. 1990 99 p
(EUT-90-E-247; ISBN-90-6144-247-8; ISSN-0167-9708; ETN-91-99627) Avail: NTIS HC/MF A05

If the specification of a given sequential machine (or its part) is strongly similar to the specification of a given standard machine then there is a great chance to reach a better solution by decompositional implementation. By constructing a modified version of the method of maximal adjancencies the question of how to find the (sub) optimal sequential decomposition of a given sequential machine into a number of submachines defining counters and a small general sequential submachine is answered. The precise algorithm for computing the (sub) optimal state chains and the (sub) optimal state codes is described in the report and illustrated with examples. ESA

N91-30852# Universiteit Twente, Enschede (Netherlands). Knowledge-Based Systems Group.
ABSTRACTION IN AI: A STUDY OF RELEVANT LITERATURE IN THE CONTEXT OF MODEL-BASED DIAGNOSIS
D. J. Out and E. Hammink Jan. 1991 126 p Sponsored in part by Stichting Knowledge-Based Systems
(Memo-INF-91-07; UT-KBS-91-01; SKBS/A1/91-04; ISSN-0923-1714; ETN-91-99689) Avail: NTIS HC/MF A07

Model based diagnosis is a research area which suffers greatly from complexity problems. Using a model of a device coupled with input/output information, the problem of finding all possible diagnoses for that device is very difficult. In the diagnosis literature, abstraction is often seen as a way to partially circumvent this problem. As different authors use different definitions of the concept abstraction, this literature is very fragmented. The result of a study of the literature on abstraction, not only in model based diagnosis, but also in three other artificial intelligence (AI) research areas, theorem proving, planning and simulation, is presented. ESA

N91-30853# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
KNOWLEDGE-BASED DIAGNOSIS OF TECHNICAL SYSTEMS Progress Report, 1988-1990
R. R. Bakker, ed. Feb. 1991 96 p
(Memo-INF-91-17; UT-KBS-91-03; SKBS-A1/91-05; ISSN-0923-1714; ETN-91-99698) Avail: NTIS HC/MF A05

An introduction into knowledge based diagnosis is given. Using model based reasoning by diagnosing Philips P9000 computer systems leads to two well known problems in model based diagnosis: reasoning (how to handle the large computational complexity of existing reasoning methods), and modeling (how to obtain a model that can be used for diagnostic purposes). The problem of the high computational complexity of model based reasoning is tackled in several ways: use of abstract behavioral descriptions, hierarchic reasoning, preprocessing diagnostic reasoning, and redefining the diagnostic problem. The problem of modeling is related to the problem of efficient reasoning. Relevant aspects of modeling are identified. By developing a prototype diagnostic system for Philips P9000 computer systems, the technical feasibility of the approach is demonstrated. Based on the research results and the practical work of the development of a prototype diagnostic system for Philips P9000 computer systems, developing model based diagnostic programs for medium sized static modeled systems is concluded to be technically feasible. ESA

64 NUMERICAL ANALYSIS

Includes iteration, difference equations, and numerical approximation.

N91-30854# Oak Ridge National Lab., TN.
INTEGRAL METHODS FOR SOLVING FOKKER-PLANCK-TYPE EQUATIONS
V. Protopopescu 1990 14 p Presented at the International Conference on Integral Methods in Science and Engineering, Arlington, 15-18 May 1990
(Contract DE-AC05-84OR-21400)
(DE90-012171; CONF-9005223-1) Avail: NTIS HC/MF A03

Fokker-Planck-type equations occur quite often in different domains of physics and applied mathematics as various realizations of a generic degenerate parabolic equation. Even in the simplest situations, the analysis of the general Fokker-Planck equation is difficult and has been mostly confined to linear cases, where partial results have been obtained in showing existence, uniqueness, regularity, and completeness of eigenfunctions. In the present paper, we present a canonical integral approach that solves, in principle, the most general linear or nonlinear Fokker-Planck-type equations. The method is formal in the sense that it does not provide per se the means to prove existence and uniqueness of the solution in an abstract setting. The formalism is based on the Green's functions and their natural extensions to nonlinear systems and allows one to compute the solution (assumed to exist uniquely), by using a canonical iterative scheme. We present several applications of the integral approach in connection with previously developed methods and results. DOE

N91-30855# Purdue Univ., West Lafayette, IN. Dept. of Computer Sciences.
SURFACE APPROXIMATIONS IN GEOMETRIC MODELING M.S. Thesis
Jung-Hong Chuang Sep. 1990 129 p
(Contracts N00014-86-K-0465; N00014-90-J-1599; NSF CCR-86-19817)
(AD-A229330; CSD-TR-1023; CER-90-37) Avail: NTIS HC/MF A07 CSCL 12/2

One of the major research efforts in the field of solid modeling focuses on extending the geometric coverage of modeling systems and on incorporating complex free-form surfaces. Some major obstacles to this goal include computing and rendering very complex surfaces, including offset, Voronoi, and blending surfaces. Local and global approximation schemes are presented which are expected to be of practical value in overcoming the above problems. For parametric curves and surfaces, a method is presented for computing an implicit approximant of low degree that approximates the curves or surface locally and achieves an order of contact that can be prescribed in advance. In principle, the method is capable of exact implicitization. GRA

N91-30856# Applied Research Lab., State College, PA.
SOLVING LEAST SQUARES PROBLEMS ON DISTRIBUTED MEMORY MACHINES
Udaya Bhaskar and V. S. Vemulapati Dec. 1990 98 p
(Contract N00039-88-C-0051)
(AD-A229501; PSU/ARL-TR-90-015) Avail: NTIS HC/MF A05 CSCL 12/1

We consider solving unconstrained least squares and equality constrained least squares problems on distributed memory multi-processors. First, we examine some issues related to matrix computations in general, on such architectures. We then describe three different algorithms to compute an orthogonal factorization of a matrix on a multi-processor, which are well suited for dense matrices. As for sparse matrices, efficient solution of problems involving large, sparse matrices on distributed memory multi-processors calls for the use of static data structures. Often, at the same time, it is critical to detect the rank of a matrix during the factorization to accurate results. We describe a rank detection strategy, using an incremental condition estimator, that computes a factorization using pre-determined static data structure. We present experimental evidence to show that the accuracy of the rank detection algorithm is comparable to the column pivoting and another recent procedure by Bischof. We further demonstrate that the algorithm is quite suitable for parallel sparse matrix factorizations, by showing good speed-ups on a hypercube with up to 128 processors. We use this algorithm to detect the rank of the constraint matrix in solving the equality constrained least squares problem. We use the weighting approach to solve the equality constrained least square problem, with two iterations of modified deferred correction technique, to improve the accuracy of the original solution. GRA

N91-30857# Connecticut Univ., Storrs. Dept. of Mathematics.
MULTIVARIATE MULTISCALE ANALYSIS Final Report, 15 Sep. 1989 - 14 Sep. 1990
W. R. Madych 8 Nov. 1990 84 p
(Grant AF-AFOSR-0524-89)
(AD-A229502) Avail: NTIS HC/MF A05 CSCL 12/3

The principal investigator produced five published papers during the period of support. The work centered on questions of Fourier/wavelet analysis. This is an area which promises to have a major impact on signal processing and numerical analysis and requires careful theoretical underpinning. Dr. Madych has resolved several questions related to translation invariance, multiscale analysis and Radon transforms. The following subject areas are covered: (1) translation invariant multiscale analysis; (2) polyharmonic splines, multiscale analysis, and entire functions; (3) summability and approximate reconstruction from Radon transform data; (4) bounds on multivariate polynomials and exponential error estimates for multiquadric interpolation; and (5) error estimates for interpolation by generalized splines. GRA

N91-30858# International Centre for Theoretical Physics, Trieste (Italy).
THE MULTI-POLE NEVEU-SCHWARZ ALGEBRA ON RIEMANN SUPERSPHERE
Zhe Chang Aug. 1990 14 p
(DE91-617612; IC-90/255) Avail: NTIS HC/MF A03

According to the Riemann-Roch theorem, we construct bases H(sub -n)(sup i) and N(sub -m)(sup j), for the meromorphic lambda = -1 and lambda = -1/2 differentials on the Riemann sphere S(sup 2). The dual bases, A(sub -n)(sup i) and D(sub -m)(sup j), of these meromorphic lambda differentials on C(sub r) curves are defined. Expanding the component fields T(sub B)(z) and T(sub F)(z) of the stress-energy tensor T(z) in the superconformal field

theory by the dual bases A(sub -n)(sup i) and D(sub -m)(sup j), respectively, we obtain a series of expanding coefficients. The commutation relations among these coefficients are given explicitly, which is just the multi-pole Neveu-Schwarz algebra with central extensions on Riemann supersphere S-circumflex(sup 2). Physical implications of the algebra are also discussed. DOE

N91-30859 Purdue Univ., West Lafayette, IN.
RELIABILITY STUDY OF UNCERTAIN STRUCTURES USING STOCHASTIC FINITE ELEMENTS Ph.D. Thesis
Der-Guang Leslie Liaw 1990 144 p
Avail: Univ. Microfilms Order No. DA9116422

A stochastic finite element method was developed to study the reliability of structures such as beams, columns, plates, and shells with structural uncertainties due to variabilities that occurred during the fabricating process. The three failure criteria considered are static displacement, buckling, and supersonic flutter. The structural uncertainties include modulus of elasticity, mass density, thickness, fiber orientation geometric imperfection of the structure, in-plane load, mass density of air, and modulus of elastic foundation. The stochastic finite elements formulated include a six degree of freedom two dimensional beam column element and a 48 degree of freedom doubly-curved quadrilateral laminated thin shell element. The results quantify the effects of uncertainty parameters on the reduction of structural reliability and stability boundaries of the uncertain structures. The results also provide physical insight into such practical design and fabrication problems. Dissert. Abstr.

N91-30860*# Michigan Univ., Ann Arbor. Radiation Lab.
USE OF EDGE-BASED FINITE ELEMENTS FOR SOLVING THREE DIMENSIONAL SCATTERING PROBLEMS Technical Report, Feb. - Sep. 1991
A. Chatterjee, J. M. Jin, and John L. Volakis Aug. 1991 39 p
(Grant NAG2-541)
(NASA-CR-188735; NAS 1.26:188735; TR-025921-22T) Avail: NTIS HC/MF A03 CSCL 12A

Edge based finite elements are free from drawbacks associated with node based vectorial finite elements and are, therefore, ideal for solving 3-D scattering problems. The finite element discretization using edge elements is checked by solving for the resonant frequencies of a closed inhomogeneously filled metallic cavity. Great improvements in accuracy are observed when compared to the classical node based approach with no penalty in terms of computational time and with the expected absence of spurious modes. A performance comparison between the edge based tetrahedra and rectangular brick elements is carried out and tetrahedral elements are found to be more accurate than rectangular bricks for a given storage intensity. A detailed formulation for the scattering problem with various approaches for terminating the finite element mesh is also presented. Author

N91-30861# Technische Hogeschool Twente, Enschede (Netherlands). Dept. of Applied Mathematics.
QUANTIFICATION IN KNOWLEDGE GRAPHS
H. vandenBerg and M. Willems Jun. 1990 26 p
(PB91-185819; MEMO-872; ISSN-0169-2690) Avail: NTIS HC/MF A03 CSCL 12A

Described here is the representation of the words all, every, each, and any, indicating universal quantification in the formalism of knowledge graphs. This is done by defining a new relation, the Skolem relation. Author

N91-30862# Technische Hogeschool Twente, Enschede (Netherlands). Dept. of Applied Mathematics.
A GRAPH-THEORETICAL ANALYSIS OF THE CONCEPT OF COOPERATION
Cornelis Hoede Oct. 1990 16 p
(PB91-185413; MEMO-892; ISSN-0109-2690) Avail: NTIS HC/MF A03 CSCL 12A

Actors that have the same issues as goals form an action group. Actors, goal issues, and factors form an issue network. The concept of cooperation is analyzed over this issue network. Author

N91-30863# National Inst. of Standards and Technology, Gaithersburg, MD. Applied and Computational Mathematics Div.
CONVERGENCE PROPERTIES OF A CLASS OF RANK-TWO UPDATES
P. T. Boggs and J. W. Tolle Apr. 1991 49 p Prepared in cooperation with North Carolina Univ., Chapel Hill
(Grants AFOSR-ISSA-90-0004; AF-AFOSR-0267-88)
(PB91-187799; NISTIR-4554) Avail: NTIS HC/MF A03 CSCL 12A

Many optimization algorithms generate, at each iteration, a pair x sub k, H sub k, consisting of an approximation to the solution, x sub k, and a Hessian matrix approximation, H sub k, which contains local second order information about the problem. Much is known about the convergence of the x sub k to the solution of the problem but relatively little about the behavior of the sequence of matrix approximations. The sequence H sub k generated by the extended Broyden class of updating schemes is analyzed independently of the optimization setting in which they are used, deriving various conditions under which convergence is assured and delineating the structure of the limits. Rates of convergence are also obtained. The results extend and clarify those already in the literature. Author

N91-30864# Technische Hogeschool Twente, Enschede (Netherlands). Dept. of Computer Science.
FIBONACCI-LIKE ITERATED NONLINEAR MAP
P. R. J. Asveld Mar. 1990 10 p
(PB91-185439; Memo-INF-90-09) Avail: NTIS HC/MF A02 CSCL 12A

A second order Fibonacci-like iterated nonlinear map that contains two parameters of which one is kept fixed, whereas the other one varies from 0 to 1. This gives rise to some complicated behavior which is displayed in a few interesting pictures. Author

N91-30865*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
A COMPARISON OF NUMERICAL METHODS FOR THE RAYLEIGH EQUATION IN UNBOUNDED DOMAINS
W. W. Liou and P. J. Morris (Pennsylvania State Univ., University Park.) Aug. 1991 34 p
(NASA Order C-99066-G)
(NASA-TM-105179; ICOMP-91-13; E-6476; NAS 1.15:105179; CMOTT-91-4) Avail: NTIS HC/MF A03 CSCL 12A

A second-order finite difference and two spectral methods, including a Chebyshev tau and a Chebyshev collocation method were implemented to determine the linear hydrodynamic stability of an unbounded shear flow. The velocity profile of the basic flow in the stability analysis mimicks that of a one-stream free mixing layer. Local and global eigenvalue solution methods are used to determine individual eigenvalues and the eigenvalue spectrum, respectively. The calculated eigenvalue spectrum includes a discrete mode, a continuous spectrum associated with the equation singularity and a continuous spectrum associated with the domain unboundedness. The efficiency and the accuracy of these discretization methods in the prediction of the eigensolutions of the discrete mode were evaluated by comparison with a conventional shooting procedure. Their capabilities in mapping out the continuous eigenvalue spectra are also discussed. Author

N91-30866*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
THE CONVERGENCE RATE OF APPROXIMATE SOLUTIONS FOR NONLINEAR SCALAR CONSERVATION LAWS Final Report
Haim Nessyahu and Eitan Tadmor (Tel-Aviv Univ., Israel) Jul. 1991 22 p Submitted for publication
(Contracts NAS1-18605; N00014-91-J-1076)
(NASA-CR-187608; NAS 1.26:187608; ICASE-91-62) Avail: NTIS HC/MF A03 CSCL 12A

The convergence rate is discussed of approximate solutions

for the nonlinear scalar conservation law. The linear convergence theory is extended into a weak regime. The extension is based on the usual two ingredients of stability and consistency. On the one hand, the counterexamples show that one must strengthen the linearized L(sup 2)-stability requirement. It is assumed that the approximate solutions are Lip(sup +)-stable in the sense that they satisfy a one-sided Lipschitz condition, in agreement with Oleinik's E-condition for the entropy solution. On the other hand, the lack of smoothness requires to weaken the consistency requirement, which is measured in the Lip'-(semi)norm. It is proved for Lip(sup +)-stable approximate solutions, that their Lip'convergence rate to the entropy solution is of the same order as their Lip'-consistency. The Lip'-convergence rate is then converted into stronger L(sup p) convergence rate estimates. Author

N91-30867*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
A NEW NUMERICAL FRAMEWORK FOR SOLVING CONSERVATION LAWS: THE METHOD OF SPACE-TIME CONSERVATION ELEMENT AND SOLUTION ELEMENT
Sin-Chung Chang and Wai-Ming To (Sverdrup Technology, Inc., Brook Park, OH.) Aug. 1991 115 p
(NASA-TM-104495; E-6403; NAS 1.15:104495) Avail: NTIS HC/MF A06 CSCL 12A

A new numerical framework for solving conservation laws is being developed. It employs: (1) a nontraditional formulation of the conservation laws in which space and time are treated on the same footing, and (2) a nontraditional use of discrete variables such as numerical marching can be carried out by using a set of relations that represents both local and global flux conservation. Author

N91-30868 Politecnico di Milano (Italy). Dipartimento di Elettronica.
WEIGHTED k-CARDINALITY TREES
Horst W. Hamacher (Kaiserslautern Univ., Germany, F.R.) and Francesco Maffioli 1991 9 p Sponsored in part by Italian Ministry of University and Scientific and Technological Research (Grant NATO-RG-85-0240)
(Rept-91-023; ETN-91-99769) Avail: Politecnico de Milano, Piazzo Leonardo da Vinci 32, 20133 Milan, Italy

The problem of finding a minimal weighted spanning tree is a classical combinatorial optimization problem with a variety of applications. It can be solved efficiently with the Greedy algorithm. The problem is modified by considering trees with a given cardinality k (k-cardinality trees). It is shown that finding a minimal weight k-cardinality tree is NP-hard. Lower and upper bounds for the problem can be obtained by applying the algorithm of Prim and the Greedy algorithm respectively, and terminating the algorithms as soon as an edge set of cardinality k is reached. An integer programming formulation of the problem is given. Some strategies for implementing a solution procedure are suggested. ESA

N91-30869# European Space Agency, Paris (France).
ESTIMATION AND REPRESENTATION OF MULTIDIMENSIONAL MAPPINGS
Friedrich Lange (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen, Germany, F.R.) May 1991 189 p Transl. into ENGLISH of Schaetzung und Darstellung von Mehrdimensionalen Abbildungen (Oberpfaffenhofen, Fed. Republic of Germany, DLR), 1990 145 p Original language document was announced as N90-29967
(ESA-TT-1223; DLR-Mitt-90-06; ETN-91-99803) Avail: NTIS HC/MF A09

The method of estimation and representation is a software tool for determining a nonlinear function of several continuous input variables using knowledge of the possibly disturbed functional values at different stochastic points. With this method, it is possible to update the estimate at any time without meanwhile restricting the availabiliy of the estimates. The ability of iterative recall and training using optimal filtering renders the method suitable for tasks which previously required associative memories. Moreover, it is a genuine alternative to approximation methods. The output of a parameter vector also renders possible locally valid parametric representations of the function. The method can be used for a range of tasks, e.g. recording and storing of characteristic lines, knowledge of which is used simultaneously in control of for generating learning controllers. ESA

N91-30870# Sheffield Univ. (England). Dept. of Control Engineering.
A RECURSIVE HYBRID ALGORITHM FOR NON-LINEAR SYSTEM IDENTIFICATION USING RADIAL BASIS FUNCTION NETWORKS
S. Chen, S. A. Billings, and P. M. Grant (Edinburgh Univ., Scotland) Jan. 1991 28 p
(RR-422; ETN-91-99467) Avail: NTIS HC/MF A03

Recursive identification of nonlinear systems is investigated using radial basis function networks. A novel approach is adopted which employs a hybrid clustering and least squares algorithm. The recursive clustering algorithm adjusts the centers of the radial basis function network while the recursive least squares algorithm estimates the connection weights of the network. This hybrid algorithm significantly enhances the real time or adaptive capability of radial basis function models. The application to simulated and real data are included to demonstrated the effectiveness of this hybrid approach. ESA

N91-30871 Politecnico di Milano (Italy). Dipartimento di Elettronica.
DYNAMIC SIMULATION OF ROBOTS INTERACTING WITH STIFF CONTACT SURFACES
G. Ferretti, C. Maffezzoni, and G. Magnani 1990 41 p
(Rept-90-052; ETN-91-99513) Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

A simulation environment for the dynamic simulation of robot manipulators, moving either in the free space or in interaction with surfaces is presented. The simulation environment is based on a general purpose DAE (Differential Algebraic Equation) solver, which makes the modular approach to modeling easier not only with reference to the modeling of the robotic chain (obtained by connecting Newton-Euler link submodels), but also and especially with reference to the modeling of the interactions with external constraint and to the connection of the robot model with auxiliary subsystems, such as motors and gear boxes. The collision surfaces are modeled either as compliant surfaces, thus assigning a relation between strain and reaction force, or as perfectly rigid surfaces, which are considered interacting with the robot by means of force impulses. Particular attention is paid to modeling the transition from one motion regime to another: motion in free space, impulsive collision, and sliding motion. The model of friction is also introduced. To show the performance of the simulation environment a case study that refers to the real robot MANUTEC R3 is considered. The two surface models are finally compared, on the basis of the simulation results, and some consideration on the simulation problems encountered are made. ESA

N91-30872# Loughborough Univ. of Technology (England). Dept. of Mathematical Sciences.
ON OPTIMALLY AND NEAR-OPTIMALLY CONDITIONED QUASI-NEWTON UPDATES
Y. F. Hu and C. Storey Mar. 1991 28 p
(Maths-Rept-A-141; ETN-91-99544) Avail: NTIS HC/MF A03

The self scaling Broyden family of quasi Newton updates depends on two free parameters. A full analysis on how these parameters must be selected so as to minimize the condition of an appropriate matrix is presented. ESA

N91-30873# Amsterdam Univ. (Netherlands). Dept. of Mathematics and Computer Science.
GENERAL DYNAMICS
Johan vanBenthem Aug. 1990 46 p Submitted for publication
(ITLI-LP-90-11; ISSN-0924-2082; ETN-91-99563) Avail: NTIS HC/MF A03

The proposition of a general model for constructing the interplay

of content and action in cognitive notions is addressed. The mathematical core is not new, being derived from existing systems of relational algebra and dynamic logic. Its wide applicability and unifying power across a great variety of apparently diverse research lines is shown. Technical proposals for studying such issues as the proper choice of fundamental dynamic logical constants, charting the variety of dynamic forms of inference, and the systematic interplay between newer forms of procedural logic and the original standard systems, are made. Pertinant questions such as the ontological status of transitions as a new basic category, or the complexity of more procedural systems of logic, are discussed. ESA

N91-30874# Amsterdam Univ. (Netherlands). Dept. of Mathematics and Computer Science.
HOW TO SHARE CONCURRENT WAIT-FREE VARIABLES
Ming Li, John Tromp, and Paul M. B. Vitanyi (Center for Mathematics and Computer Science, Amsterdam, Netherlands) Mar. 1991 34 p
(Contracts N00014-85-K-0445; DAAL03-86-K-0171; NSF DCR-86-06366; NSERC-OGP-0036747)
(ITLI-CT-91-02; ISSN-0924-8374; ETN-91-99572) Avail: NTIS HC/MF A03

Sharing data between multiple asynchronous users, each of which can both read and write the data such that the accesses are serializable and free from waiting, is a feature which may help to increase the amount of parallelism in distributed systems. An algorithm implementing this feature is presented. Using a structured, top down approach, a better understanding of what the algorithms do, why they do it, and a correct implementation of the specification is obtained. The main construction of an n user atomic variable directly from single writer, single reader atomic variable uses O(n) control bits per subvariable and O(n) acesses to subvariables per read/write action. ESA

N91-30875# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
A FORMAL THEORY OF SETS IN OBJECT-ORIENTED CONTEXTS (EXTENDED ABSTRACT)
Herman Balsters and Chris C. deVreeze Mar. 1991 13 p
(Memo-INF-90-74; ISSN-0923-1714; ETN-91-99666) Avail: NTIS HC/MF A03

An account is given of extending the well known object oriented type system of Luca Cardelli with set constructs and logical formalism. The system is based on typed lambda notation, employing a subtyping relation and a powertype construct. Sets in this system are expressions and are typed as some powertype. Sets are built up in a very general manner; in particular, sets can be described by (first order) predicates. The resulting system, called LPT, is statically typecheckable (in a context of multiple inheritance) and is provided with a set theoretic semantics. LPT can be used as mathematical foundation for an object oriented data model employing sets and constraints. ESA

N91-30876# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
INHERITANCE IN AN OBJECT-ORIENTED DATA MODEL
Peter M. G. Apers, Herman Balsters, Rolf A. deBy, and Chris C. deVreeze Dec. 1990 20 p Sponsored in part by Netherlands Organization for Applied Scientific Research, TNO
(Memo-INF-90-77; ISSN-0923-1714; ETN-91-99668) Avail: NTIS HC/MF A03

Influences from artificial intelligence and programming languages have resulted in two main streams in the area of data models: logical databases and object oriented databases. The long term goal is to integrate the two ideas, but before doing that object oriented data models have to be given a formal semantics. One of the most powerful concepts in object oriented data models is specialization/generalization, because it allows the designer to specify attributes, methods (retrieval and updates), and constraints at the right level in the hierarchy. A consequence of this is that it should be possible to 'inherit' attributes, methods, and constraints specified at higher levels by the lower levels in the hierarchy. An overview of the formalization of inheritance in TM, an object oriented data model, is given. ESA

N91-30877# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
ON THE STRUCTURE OF SPECIAL VECTORS OF THE VIRASORO ALGEBRA
Y. Kotchetkov, G. Post, and M. Roelofs 7 Jan. 1991 8 p
(MEMO-927; ISSN-0169-2690; ETN-91-99728) Avail: NTIS HC/MF A02

Explicit formulas for parts of singular vectors for verna-modules of the Virasoro algebra are given. Virasoro algebra 5 is the central extension of Witt algebra W which is the Lie algebra of polynomial vectorfields on the circle. Laurent polynomials of the variable t are investigated. The case k equal to n and l equal to 1 is considered. In this case the Laurent polynomials become ordinary polynomials in t. ESA

N91-30878# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
DEFINING RELATIONS FOR LIE ALGEBRAS OF VECTOR FIELDS
N. vandenHijligenberg and G. Post 8 Jan. 1991 15 p
(MEMO-928; ISSN-0169-2690; ETN-91-99729) Avail: NTIS HC/MF A03

Defining relations of the graded nilpotent positive part of Lie algebras of vector fields are calculated. These calculations suggest that for W sub n, S sub n, and K sub n, there are only trivial relations, i.e. relations of degree 2. For H sub n, it is proven that there are nontrivial relations of degree 3, which form a standard module. ESA

N91-30879# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
MULTIGRID AND RUNGE-KUTTA TIME STEPPING WITH FROZEN DISSIPATION APPLIED TO THE TOTAL VARIATION DIMINISHING ROE-SWEBY SCHEME
J. W. vanderBurg, J. G. M. Kuerten, and P. J. Zandbergen Feb. 1991 9 p
(MEMO-936; ISSN-0169-2690; ETN-91-99734) Avail: NTIS HC/MF A02

The Roe-Sweby scheme is a high resolution, second order, total variation diminishing, explicit scalar difference scheme for solving conservation laws. It is obtained by the addition of a limited antidiffusive flux to Roe's first order scheme. It is shown that this scheme has a better steady state convergence than Jameson's scheme and Harten's UNO scheme in case a multigrid technique and Runge-Kutta time stepping with frozen dissipation are applied. The scheme is concluded to be a promising candicate for extension to two dimensional systems of conservation laws. ESA

65 STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

N91-30880# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
ROUTING STATISTICS FOR UNQUEUED BANYAN NETWORKS Memorandum Report
Thomas F. Knight, Jr. and Patrick G. Sobalvarro Sep. 1990 21 p
(Contracts N00014-88-K-0825; N00014-85-K-0124)
(AD-A229321; AI-M-1011) Avail: NTIS HC/MF A03 CSCL 12/7

Banyan networks comprise a large class of networks that have been used for interconnection in large scale multiprocessors and telephone switching systems. Regular variants of Banyan networks, such as delta and butterfly networks, have ben used in multiprocessors such as the IBM RP3 and the BBN Butterfly. Analysis of the performance of Banyan networks has typically

focused on these regular variants. A methodology is presented for performance analysis of unbuffered Banyan multistage interconnection networks. The methodology has two novel features. It allows analysis of networks where some inputs are more likely to be active than others, and it allows analysis of Banyan networks of arbitrary topology. A Banyan network is a network in which there is a unique path from each input to each output. GRA

N91-30881# RRC, Inc., Bryan, TX.
NEURAL NETWORKS: A PRIMER Final Report, Sep. 1989 - Mar. 1991
Vince L. Wiggins, Larry T. Looper, and Sheree K. Engquist May 1991 38 p
(Contract F41689-88-D-0251)
(AD-A235920; AL-TP-1991-0011) Avail: NTIS HC/MF A03
CSCL 12/7

Neural network technology has recently demonstrated capabilities in areas important to personnel research such as statistical analysis, decision modeling, control, and forecasting. This paper is an introduction to neural network terminology, definitions, capabilities, and applications. It provides a discussion of traditionally used statistical methods and compares them to neural network architectures. The benefits of using neural networks is their ability to derive nonlinear and interacting relationship among variables of a model. This paper is designed for individuals who have little or no knowledge of this growing field. GRA

N91-30882# ManTech Environmental Technology, Inc., Research Triangle Park, NC.
REGRESSION ON MEDIANS OF PROBABILITY DISTRIBUTIONS
M. R. Sumier, H. L. Fisher, and L. L. Hall 1991 20 p Sponsored by Health Effects Research Lab., Research Triangle Park, NC
(Contract EPA-68-02-4450)
(PB91-177006; EPA/600/D-91/048) Avail: NTIS HC/MF A03
CSCL 12A

The medium is a fundamental parameter in the area of lifetime and survival statistics. In toxicodynamics the LD50, lethal dose that results in 50 percent mortality, is frequently used. The median is also used to describe the incidence of cancer and other disease states. Factors such as nutritional status, age of animal, and exposure to a second chemical can cause the LD50 to shift. It is therefore desirable to determine a functional relationship between the median of a distribution and a cofactor. The SAS was used to examine the use of median regression to predict a continuous dependent variable as a function of a single cofactor and compare these results to the standard ordinary least squares regression techniques. Two data sets were generated using the SAS RANUNI and NORMAL functions. In one, the median line was proportional to the mean line, and both the median and mean had positive slopes with respect to a cofactor. In the other, the slope of the median line was positive while that of the mean line was negative. Author

N91-30883# Groningen Rijksuniv. (Netherlands). Dept. of Mathematics.
THE ISLAMIC MEAN Thesis [HET ISLAMITISCHE GEMIDDELDE]
Cor H. Moes May 1990 42 p In ENGLISH and DUTCH
(W-9006; ETN-91-99575) Avail: NTIS HC/MF A03

The limit behavior of the Islamic Mean (IMn) was studied. The iMn is an L scatter of some location parameter. In two cases, namely that of the uniform and the exponential distribution, it is demonstrated that the Islamic mean is a strongly consistent estimator of the population median and of the sampling median Mn. It is shown that IMn and Mn are asymptotically equal. Therefore, the limit distribution of the IMn is equal to the limit distributic ı of Mn. ESA

N91-30884# Royal Signals and Radar Establishment, Malvern (England). Pattern Processing Principles Section.
A TRAINABLE TEXTURE ANOMALY DETECTOR USING THE ADAPTIVE CLUSTER EXPANSION (ACE) METHOD
Stephen P. Luttrell 5 Nov. 1990 40 p
(RSRE-Memo-4437; BR300023; ETN-91-99843) Copyright
Avail: NTIS HC/MF A03

An adaptive hierarchical maximum entropy estimate of probability density functions, whose mathematical structure suggests the name Adaptive Cluster Expansion (ACE) is derived. ACE is applied to the problem of locating statistically anomalous regions in otherwise homogeneous textured images, which is demonstrated using several images of Brodatz textures. ESA

N91-30885# Sheffield Univ. (England). Dept. of Control Engineering.
RECURSIVE PARAMETER ESTIMATIONS FOR NONLINEAR RATIONAL MODELS
Q. M. Zhu and S. A. Billings 17 Jan. 1991 25 p
(Grant SERC-GR/F2417-7)
(RR-420; ETN-91-99465) Avail: NTIS HC/MF A03

A new recursive parameter estimation algorithm is derived for a general class of stochastic nonlinear systems which can be represented by a rational model defined as the ratio of two polynomial expansions of past inputs, outputs, and prediction error terms. Simulation results are included to illustrate the performance of the new algorithm. ESA

N91-30886# Grenoble-1 Univ. (France). Lab. de Modelisation et Calcul.
FAST ALGORITHMS FOR CROSS VALIDATION IN NONLINEAR APPROXIMATION PROBLEMS Ph.D. Thesis [DES ALGORITHMES RAPIDES POUR LA VALIDATION CROISEE SUR DES PROBLEMES D'APPROXIMATION NON LINEAIRES]
Lalita Narhar Deshpande 1990 106 p In FRENCH
(ETN-91-99487) Avail: NTIS HC/MF A06

Two Monte Carlo methods are proposed for the calculations of the trace of the derivative of the nonlinear regulating operator in Generalized Cross Validation (GCV). The first method is a direct extension of the Girard method, as proposed in the linear case. The second is an original formula, using derivative approximation by finite differences. A comparison is presented between the exact calculation of the trace and these Monte Carlo estimators. Numerical experiments realized on various problems show the good performance characteristics of GCV methods. GCV methods also allow the position of a discontinuity for noisy data with Poisson type errors to be determined. ESA

N91-30887 Politecnico di Milano (Italy). Dipartimento di Elettronica.
RECURSIVE ESTIMATION OF TIME DELAY IN SAMPLED SYSTEMS
G. Ferretti, C. Maffezzoni, and R. Scattolini 1990 31 p Sponsored in part by Italian Ministry of University and Scientific Research
(Rept-90-046; ETN-91-99512) Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

An identification method based on standard recursive least squares for the estimation of time delay in linear sampled systems is presented. The algorithm relies on the fact that if the continuous time model has a delay or anticipation shorter than one sampling time, then a real negative zero arises in the corresponding sampled system. By inspection of the phase contribution of this zero, the value of the delay is recursively updated. A frequency domain analysis is performed to examine the characteristics of the algorithm. Simulation results illustrate the performances of the time delay estimation algorithm. ESA

N91-30888# Amsterdam Univ. (Netherlands). Dept. of Mathematics and Computer Science.
KOLMOGOROV COMPLEXITY ARGUMENTS IN COMBINATORICS
Ming Li and Paul M. B. Vitanyi (Center for Mathematics and Computer Science, Amsterdam, Netherlands) Mar. 1991 16 p Sponsored in part by Canadian Natural Sciences and Engineering Research Council International Scientific Exchange Award

(Grants NSERC-OGP-0036747; NSERC-OGP-046506)
(ITLI-CT-91-01; ISSN-0924-8374; ETN-91-99571) Avail: NTIS HC/MF A03

The utility of Kolmogorov complexity method in combinatorial theory is demonstrated by several examples. Theorems regarding tournaments, the coin weighing problem, and covering families are considered. It is only important in the study to study that the utility is not restricted to trivialities. ESA

N91-30889# Amsterdam Univ. (Netherlands). Dept. of Mathematics and Computer Science.
AVERAGE CASE COMPLEXITY UNDER THE UNIVERSAL DISTRIBUTION EQUALS WORST CASE COMPLEXITY
Ming Li and Paul M. B. Vitanyi (Center for Mathematics and Computer Science, Amsterdam, Netherlands) Mar. 1991 10 p Sponsored in part by Canadian Natural Sciences and Engineering Research Council International Scientific Award
(Grant NSERC-OGP-0036747)
(ITLI-CT-91-03; ISSN-0924-8374; ETN-91-99573) Avail: NTIS HC/MF A02

The average complexity of any algorithm (provided it always terminates) under the universal distribution is of the same order of magnitude as the worst case complexity. This holds both for time complexity and for space complexity. The particular case of sorting algorithms, and the general case of the average case complexity of NP complete problems, are focused to discuss average case complexity. ESA

N91-30890# National Aerospace Lab., Amsterdam (Netherlands). Informatics/Flight Div.
BAYESIAN TRACK INITIATION BY TIME-REVERSION OF TRAJECTORY MODELS
Rene A. Hogendorn and Henk A. P. Blom 30 Jan. 1989 11 p Presented at 1989 IEEE International Conference on Control and Applications, Jerusalem, Israel, 3-6 Apr. 1989
(NLR-TP-89043-U; ETN-91-99640) Avail: NTIS HC/MF A03

The theory of Bayesian track initiation for multiple objects without a priori identification is well developed. To end up with a practically acceptable combinatorial complexity this theory requires the use of appropriate hypotheses reduction techniques. Unfortunately in cases of high false measurement densities the required hypotheses reduction is so drastic that intitially weak correct tracks are deleted before they can grow strong while initially strong false tracks survive too long. The actual result is that probabilistic track initiation is too much occupied with past measurements and too little with more recent measurements. To remedy this situation, the theory of time reversion of a Gauss Markov process to the track initiation problem is exploited. In combination with drastic hypotheses reduction it yields a probabilistic track initiation which is mainly occupied with the most recent measurements. The effectivenesss of this reverse time approach is verified by experiments. ESA

N91-30891# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
CHEBYSHEV APPROXIMATION OF A FINITE SET BY A STRAIGHT LINE
W. W. E. Wetterling and M. Streng Jan. 1991 11 p (MEMO-925; ISSN-0169-2690; ETN-91-99726) Avail: NTIS HC/MF A03

The problem of calculating the best approximating straight line, in the sense of Chebyshev to a finite set of points in the set of real numbers to the nth power is considered. First and second order optimality conditions are derived and analyzed. Some remarks are made on the numerical methods used to solve the problem. The use of this approximation system in railway engineering is illustrated. Other applications where the problem arises are in the fields of robotics and in computer assisted design and manufacture. ESA

N91-30892# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
MULTIVARIATE DIVIDED DIFFERENCES. PART 2: MULTIVARIATE B-SPLINES
M. Neamtu Feb. 1991 17 p Sponsored by Netherlands Foundation of Mathematics, and Netherlands Organization for the Advancement of Research
(MEMO-932; ISSN-0169-2690; ETN-91-99730) Avail: NTIS HC/MF A03

More properties of the multivariate divided difference are derived and the connection with multivariate B splines is further developed. Applications of the multivariate divided differences to the theory of multivariate simplex B splines are discussed. Ways in which some of the readily known properties of these splines can be derived on the basis of the divided difference functional are shown. ESA

66 SYSTEMS ANALYSIS

Includes mathematical modeling; network analysis; and operations research.

N91-30893# National Aeronautical Lab., Bangalore (India).
AN INTRODUCTION TO OPERATIONS RESEARCH
Srinivas Bhogle Dec. 1990 11 p
(NAL-PD-DU-9005) Avail: NTIS HC/MF A03

An informal introduction to operations research and its techniques is presented. Chaos, queueing theory, and network analysis are briefly examined. Author

N91-30894# Helsinki Univ. of Technology, Espoo (Finland). Systems Analysis Lab.
MODELS OF INTERTEMPORAL BARGAINING Ph.D. Thesis
Jukka Ruusunen Dec. 1990 20 p Sponsored by Jenny and Antti Wihuri Foundation; Yrjoe Jahnsson Foundation; and Finnish Doctoral Education Program of Information Technology
(Rept-A-36; ISBN-951-22-0461-4; ISSN-0782-2030;
ETN-91-99506) Avail: NTIS HC/MF A03

Bargaining situations where the contrast covers multiple time periods are studied. Application of static bargaining schemes in intertemporal problems leads into complex nonseparable optimization problems. A hierarchical approach for the solution of these problems is presented. In many real life bargaining situations, contracting takes place in the presence of exogenous uncertainty. Bargaining schemes where the cooperative policy is chosen taking into account future uncertainties are presented. As a real life application cooperative electricity exchange in a power pool is studied. Models for intertemporal electricity exchange between autonomous electric utilities with diverse load profiles and production technologies are developed. ESA

67 THEORETICAL MATHEMATICS

Includes topology and number theory.

No abstracts in this category.

70 PHYSICS (GENERAL)

For precision time and time interval (PTTI) see *35 Instrumentation and Photography;* for geophysics, astrophysics or solar physics see *46 Geophysics, 90 Astrophysics,* or *92 Solar Physics.*

N91-30895# Wave Pro, Inc., Radnor, PA.
PULSE PROPAGATION IN TEMPORALLY DISPERSIVE MEDIA Final Report, 1 Aug. 1988 - 31 Jul. 1989

Gregory A. Kriegsmann 30 Sep. 1990 6 p
(Contract F49620-88-C-0094)
(AD-A229398; AFOSR-90-1076TR) Avail: NTIS HC/MF A02 CSCL 20/3

By solving the transport equations for the amplitude of the progressing wave expansion of Maxwell's equations using the Lorentz model, the amplitudes, do not decay exponentially along the ray. Thus, one now studies more general models of the dispersive media, to determine the qualitative features for which the amplitudes do, or do not decay exponentially. Preliminary results suggest that a classification of dispersive media is obtained depending on the relative orders of the differential operators. GRA

N91-30896# Texas A&M Univ., College Station.
EXPERIMENTAL RESEARCH ON HIGH GRADIENT ACCELERATION BY WAKEFIELDS IN AN ELLIPTIC CAVITY AT THE UTA WAKE FIELD TEST FACILITY Final Report, 1 Jul. 1987 - 30 Jun. 1990
K. W. Chen 14 Nov. 1990 98 p
(Grant AF-AFOSR-0280-87)
(AD-A229503) Avail: NTIS HC/MF A05 CSCL 20/3

The main goals of the successful research program are to provide theoretical basis to analyze the wake-fields in the elliptically shaped wake-field cavity, and to examine the feasibility of applying the new idea of wake-field acceleration to beams of lasers. The theoretical research is very important due to the world-wide interest in finding new acceleration principles with higher accelerating gradients suitable for future particle accelerators. In particular, very exciting and new experimental results indicated that wake field acceleration is indeed a very viable alternative for this endeavor. The research is divided into six categories: (1) investigation of wake-field acceleration using the elliptical wake-field cavity; (2) theoretical study of dielectric wake field cavity; (3) computer code development for a wake field cavity analysis; (4) development of wake field measurement system; (5) application of wake field cavities (study of a soft x ray laser scheme); and (6) development of a laser photocathode. The design and construction of a laser photocathode was conducted for a use as an intense, short electron beam source for the wake field acceleration study. Numerical study of optimal cathode geometry was conducted and beam currents were measured. It was demonstrated that this type of photoemitter can be used as an efficient short, intense electron beam source for a compact linac design. GRA

N91-30897# National Inst. of Standards and Technology, Gaithersburg, MD.
EXTRACTING STEP GEOMETRY AND TOPOLOGY FROM A SOLID MODELER: PARASOLID-TO-STEP
T. R. Kramer 2 May 1991 56 p Prepared in cooperation with Catholic Univ. of America, Washington, DC Sponsored in part by Assistant Secretary of Defense (Production and Logistics), Washington, DC
(PB91-194449; NISTIR-4577) Avail: NTIS HC/MF A04 CSCL 20C

Parasolid is a commercial solid modeling software system. It uses a manifold boundary representation. STEP is an emerging international Standard for the Exchange of Product Model Data. Included in STEP are proposed standards for Topology and Geometry (which provide the definitions of data types required for building boundary representations) and for physical files representing products. Parasolid-to-STEP is a software system written in the C programming language for translating a Parasolid format boundary representation file giving the shape of an object into a STEP format file describing the same shape. The system handles elementary curves (lines, circle, ellipse) and surfaces (plane, sphere, cylinder, cone, torus). Author

N91-30898# National Inst. of Standards and Technology, Gaithersburg, MD.
MODEL FOR THE NON-PERTURBATIVE QCD VACUUM
M. Danos, D. Gogny, and D. Iracane Apr. 1991 34 p Prepared in cooperation with Commissariat a l'Energie Atomique, Bruyeres-le-Chatel (France)
(PB91-194407; NISTIR-4555) Avail: NTIS HC/MF A03 CSCL 20C

By treating the high momentum gluon and the quark sector as an in principle calculable effective Lagrangian, a nonperturbative vacuum state was obtained for Quantum Chromodynamics (QCD) as an infrared quark-gluon condensate. This vacuum is removed from the perturbative vacuum by an energy gap and supports a Meissner-Ochsenfeld effect. It is unstable below a minimum size and it also suggests the existence of a universal hadronization time. This vacuum thus exhibits all the properties required for color confinement. Author

N91-30899# Pulse Sciences, Inc., Agoura Hills, CA.
DEVELOPMENT OF THE ARC SHATTERING CONCEPT OF ENERGY EFFICIENT COMMINUTION OF HARD MATERIALS, ADDENDUM
J. R. Bayless and C. R. Smith Feb. 1991 25 p
(Contract DE-FC07-89ID-12882)
(DE91-014291; DOE/ID-12882/1-Add; PSI-FR-1526-Add) Avail: NTIS HC/MF A03

This report describes the results of additional efforts to demonstrate efficient comminution using the Arc-Shattering technique. This report is an Addendum to the Phase 1 Final Report. The Statement of Work (SOW) for the additional work is as follows: Extend Task 3 efforts to include construction and testing of configurations simulating continuous operating conditions. Included are: (1) a cylindrical configuration featuring an array of electrodes extending radially inward from the wall, (2) a funnel-shaped configuration, and (3) a vertical cylindrical configuration featuring countercurrent flow (ore from the top and water from the bottom to wash the fines upward to an exhaust tube). Comminution efficiency will be determined and expressed in terms of specific energy and Work Index, and optimum efficiency will be sought. Experimental variables include electrode and configuration geometry, particle size and distribution, percent solids, and electrical pulse energy. Task 6 efforts will be extended to include the results of this additional research in an addendum to the Phase 1 final report. All portions of this SOW were performed for that involving multiple electrodes. Based on the results herein, multiple electrode tests did not appear to be warranted. DOE

71 ACOUSTICS

Includes sound generation, transmission and attenuation. For noise pollution see *45 Environmental Pollution.*

N91-30900# Texas A&M Univ., College Station.
ESTIMATION OF THE TIME OF ARRIVAL OF UNDERWATER ACOUSTIC SIGNALS BY SPLINE FUNCTIONS. 1: AN INTRODUCTION Memorandum Report
Charles K. Chui 1 Oct. 1990 38 p
(Contract N62190-89-M-1536; NR Proj. RR0-1108)
(AD-A229300; NRL-MR-6572) Avail: NTIS HC/MF A03 CSCL 17/1

The underwater acoustic signal is represented by a spline curve whose initial knot lies in the interval of measurement so that it may be used to determine the time-of-arrival of the acoustic signal. The first section is devoted to demonstrating a computational procedure of spline functions using the Bernstein representations, so that the coefficient matrices in the penalized least-squares problem can be determined much more efficiently, since the coefficient matrices are usually singular when the discrete least-squares problem is considered. The second section discusses the singular value decomposition and Moore-Penroe inverses. The extremal problem that characterizes the time-of-arrival is discussed in Section 3, where existence, uniqueness, and characterization results are obtained. In particular, when linear splines are used, the extremal problem has a very elegant formulation that can be easily implemented in the computer. GRA

N91-30901# Wisconsin Univ., Milwaukee. Dept. of Psychology.
MECHANISMS MEDIATING THE PERCEPTION OF COMPLEX ACOUSTIC PATTERNS Annual Progress Report, 1 Nov. 1989 - 30 Sep. 1990
Richard M. Warren 9 Nov. 1990 106 p
(Grant AF-AFOSR-0320-88)
(AD-A229472; AFOSR-90-1163TR) Avail: NTIS HC/MF A06
CSCL 20/1

Five studies were completed: (1) It was found that, following repetition, long period (500 ms) random waveforms excised from Gaussian noise could be identified when embedded in longer segments of Gaussian noise even when the inter-stimulus interval exceeded the limits of echoic memory; (2) It was demonstrated that some spectral regions of these long-period random waveforms could be recognized with greater accuracy than others; (3) Experiments with three consecutive odd-numbered harmonics demonstrated that triads with low harmonic numbers have a pitch corresponding to the fundamental of the harmonic series, but triads centered at the 9th or 11th harmonic had pitches roughly one octave higher. Deviations from the octave were consistent with the waveform pseudoperiodicities. These pitch judgements have implications for theories concerning the bases from the dominant region of complex tones. Two series of experiments involving (4) the vowel conversion effect and (5) dichotic verbal transformations, which compared the rules governing perceptual organization of speech in Japanese and English, were carried out by the principal investigator during May and June at the Basic Research Laboratories of the Nippon Telegraph and Telephone Co., Tokyo.
GRA

N91-30902 Houston Univ., TX.
APPLICATION OF COHERENT STRUCTURE AND VORTEX SOUND THEORIES TO JET NOISE Ph.D. Thesis
James Edward Bridges 1990 293 p
Avail: Univ. Microfilms Order No. DA9110813

Coherent structures (CS) are used to illustrate how, within its strict assumptions, aeroacoustic theory can indeed predict jet noise. Velocity and sound pressure fields were measured in an excited, subsonic cold jet with low freestream turbulence located in a large anechoic chamber. Several instances of stabilized, nearly periodic, pairing were educed. Coherent vorticity was measured over the region 0 less than or = y/D less than or = 1.2, 0 less than or = x/D less than or = 5, while the coherent sound pressure was measured over polar angles 20 degree less than or equal to phi less than or equal to 125 degrees for the radial range 10 less than or = r/D less than or = 50. The interactions and sound of 3-D vortex rings were simulated using vortex filaments and free-space vortex sound theory (VST) and compared with experiments. The difference between experimental and theoretical sound fields was a dipole field which appears to come from the neglected surface integrals over the nozzle body. The importance of the nozzle body was studied, and the results are presented. The sensitivity of the sound field to variations in the vortical structures was investigated using simulations of vortex rings with 3-D perturbations and temporal jitter. Incoherence in the vorticity field was highly magnified in the sound field; only in a very clean facility, such as the one built for this work, can the coherent sound be measured well. In addition, the first full-field, time-resolved measurements of CS in an intermittently pairing jet were made, launching studies of subharmonic resonance and feedback in jets. The effect of excitation on the evolution of the first two azimuthal instability modes was measured to observe tilting of CS. Finally, a general theory was proposed which can predict the evolution of noncircular vortex rings such as squares, ellipses, and triangles.
Dissert. Abstr.

N91-30903*# Lockheed Engineering and Sciences Co., Hampton, VA.
THE NASA AIRCRAFT NOISE PREDICTION PROGRAM IMPROVED PROPELLER ANALYSIS SYSTEM
L. Cathy Nguyen Washington NASA Sep. 1991 102 p
(Contract NAS1-19000)
(NASA-CR-4394; NAS 1.26:4394) Avail: NTIS HC/MF A06
CSCL 20A

The improvements and the modifications of the NASA Aircraft Noise Prediction Program (ANOPP) and the Propeller Analysis System (PAS) are described. Comparisons of the predictions and the test data are included in the case studies for the flat plate model in the Boundary Layer Module, for the effects of applying compressibility corrections to the lift and pressure coefficients, for the use of different weight factors in the Propeller Performance Module, for the use of the improved retarded time equation solution, and for the effect of the number grids in the Transonic Propeller Noise Module. The DNW tunnel test data of a propeller at different angles of attack and the Dowty Rotol data are compared with ANOPP predictions. The effect of the number of grids on the Transonic Propeller Noise Module predictions and the comparison of ANOPP TPN and DFP-ATP codes are studied. In addition to the above impact studies, the transonic propeller noise predictions for the SR-7, the UDF front rotor, and the support of the enroute noise test program are included.
Author

N91-30904 Barrodale Computing Services Ltd., Victoria (British Columbia).
INVERSION OF ULTRASONIC TRACES Interim Report
C. Zala and L. Churchill Dec. 1989 40 p
(Contract DREP-W7708-8-0174/01-XSB)
(DREP-89-41; CTN-91-60126) Avail: NTIS HC A03

Pulse-echo ultrasonic testing is an important method for nondestructive inspection of materials and for detecting and characterizing defects. There is still a need for the development of robust and accurate inversion algorithms, especially for the case of nondestructive evaluation (NDE). Here, the forward modelling problem for the case of normal incidence (compressional and not shear waves) is considered; the required theory is presented; and an algorithm for computing a discrete ultrasonic trace, given a known wavelet and impedance profile, is presented. Then a survey, description, and comparison of four representative exact inversion methods for NDE is presented. These methods cover three general categories found in the literature; two downward continuous methods (layer stripping), a surface calculation procedure, and a polynomial recursion method. These methods were implemented on a computer and tested extensively with synthetic data, both in the absence and presence of noise. The most remarkable feature of the results is that the outputs, noise responses, and points of failure of all four inversion methods were virtually identical. Execution time was the only significant difference. All the methods are sensitive to noise for the same reason, a dependency on a point calculation for the extraction of reflection coefficients. A further evaluation of the methods lead to the conclusion that, despite the fact that they prepare for it in different ways, these exact inversion methods all perform the same calculation.
CISTI

N91-30905 Defence Research Establishment Pacific, Victoria (British Columbia).
PARABOLIC APPROXIMATIONS FOR SEISMO-ACOUSTIC WAVEGUIDE PROPAGATION
G. H. Brooke and B. T. R. Wetton Aug. 1989 52 p
(DREP-89-20; CTN-91-60127) Avail: NTIS HC A04

One-way or parabolic wave equations for propagation in seismo-acoustic waveguides are considered. By examining the effect of the parabolic approximation on the propagation of normal modes in a layered acoustic waveguide, it is demonstrated that: (1) functional approximations of the square root operator, used to derive parabolic equations (PE), are identical to the square root approximation used to calculate the horizontal wavenumbers of the associated normal mode solution of these equations, and (2) the eigenvalues and eigenvectors of the matrices, involved in advancing numerically the finite difference PE field, are directly related to the modal eigenvalues and eigenfunctions for the problem. These properties of one-way parabolic approximations are instrumental in identifying the inadequacy of conventional square root approximations when applied directly to the elastic case. In particular, it is demonstrated that the rational linear

approximation used in the seismic high angle Pade equation (SHAPE) algorithm leads to exponential growth in the numerical solutions because it does not treat properly the modes with complex wavenumbers which can exist in elastic waveguides. A new bilinear square root approximation is introduced which accommodates all mode types and leads to stable numerical solutions. This approximation allowed individual modes with real-valued wavenumbers to be propagated accurately in all of the waveguide configurations considered for numerical testing, and in the case of thick elastic layers it also gives an accurate total field prediction. Author (CISTI)

N91-30906 Defence and Civil Inst. of Environmental Medicine, Downsview (Ontario).
EVALUATING THE EFFECTIVENESS OF ACTIVE NOISE REDUCTION IN FLIGHT HELMETS
S. E. Forshaw, J. M. Rylands (Army Personnel Research Establishment, Farnborough, England), and R. B. Crabtree Aug. 1988 43 p
(DCIEM-88-RR-34; CTN-91-60217) Avail: NTIS HC A03

The advent of high powered fixed- and rotary-wing aircraft and tracked armoured fighting vehicles has increased the level of noise to which crews are exposed. Active noise reduction (ANR) offers a means of increasing the attenuation at low and mid frequencies. It relies on sensing the sound inside a circumaural device and cancelling it by means of negative feedback through a miniature speaker inside the enclosed volume. This study was carried out to investigate laboratory procedures appropriate for measuring the effectiveness of ANR devices. The procedures were: ear-canal measurements using an acoustic test fixture (an objective procedure), and masked threshold and loudness balance tests (psycho-physical procedures). In addition, the effect of ANR on signal detection and speech reception was investigated. The results do not clearly permit one procedure to be recommended for the evaluation of ANR systems. Signal detection performance and speech intelligibility may be used, but the results are specific to the acoustic environment of the listener and the detection task or speech-system parameters of the evaluation. When the attenuation of the ANR system is measured objectively with a transducer inside the earmuff/ear-canal volume, the location of the transducer affects the observed ANR attenuations. Author (CISTI)

N91-30907*# North Carolina State Univ., Raleigh. High Frequency Lab.
NOISE CHARACTERISTICS OF PASSIVE COMPONENTS FOR PHASED ARRAY APPLICATIONS Progress Report, period ending 15 Sep. 1991
M. Kemal Sonmez and Robert J. Trew 1991 36 p
(Grant NAG1-943)
(NASA-CR-187819; NAS 1.26:187819) Avail: NTIS HC/MF A03 CSCL 20A

The results of a comparative study on noise characteristics of basic power combining/dividing and phase shifting schemes are presented. The theoretical basics of thermal noise in a passive linear multiport are discussed. A new formalism is presented to describe the noise behavior of the passive circuits, and it is shown that the fundamental results are conveniently achieved using this description. The results of analyses concerning the noise behavior of basic power combining/dividing structures (the Wilkinson combiner, 90 deg hybrid coupler, hybrid ring coupler, and the Lange coupler) are presented. Three types of PIN-diode switch phase shifters are analyzed in terms of noise performance. Author

N91-30908# European Space Agency, Paris (France).
TRANSMISSION OF SOUND INSIDE AN AXISYMMETRIC STRUCTURE Ph.D. Thesis - Paris VI Univ., 1986
D. Brenot (Office National d'Etudes et de Recherches Aerospatiales, Paris, France) May 1991 248 p Transl. into ENGLISH of Transmission du Son a l'Interieur d'une Structure Axisymetrique (Paris, France, ONERA), 1987 215 p
(ESA-TT-1218; ONERA-P-1987-1; ETN-91-99800) Avail: NTIS HC/MF A11

A method which solves the problem of the transmission of sound along the axis of an axisymmetric, closed elastic structure is proposed. The method solves the Neumann problem associated with the acoustic pressure by the stationary phase method and the structural problem by a finite element method whose implementation is always possible since only the axisymmetric eigenmodes of the structure are necessary. The method is always applicable for high frequencies, and generally is so applicable, whatever the frequency, for conventional aeronautical structures. ESA

N91-30909 Physics and Electronics Lab. TNO, The Hague (Netherlands).
LOW FREQUENCY PROJECTORS FOR SOUND UNDER WATER Final Report
H. A. J. Rijnja Jan. 1991 43 p
(Contract A89/KM/628)
(FEL-90-A268; TD-90-3219; ETN-91-99811) Copyright Avail: Physics and Electronics Lab. TNO, P.O. Box 96884, 2509 JG The Hague, Netherlands

The detection of submarines by means of passive sonars becomes more difficult as the radiated noise of submarines is gradually decreasing. There is a need for active sonar transducers that produce sound at frequencies below 1000 Hz. Several kinds of low frequency transducers are presented. Commercially available transducers of the following types are discussed: double piston elements, open hollow cylinders, flextensional transducers, bender bar transducers, electrodynamical systems and hydraulically driven vibrators. ESA

N91-30910# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany, F.R.). Abt. Technische Akustik.
COMPARISON OF THE ICAO ANNEX 16 CHAPTER 10 AND CHAPTER 6 NOISE CERTIFICATION PROCEDURES ON THE BASIS OF FLIGHT NOISE MEASUREMENTS OF TEN LIGHT PROPELLER-DRIVEN AEROPLANES
Helmut Dahlen and Hanno Heller Nov. 1990 52 p
(DLR-Mitt-90-17; ISSN-0939-298X; ETN-91-99542) Avail: NTIS HC/MF A04; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, HC 11 Deutsche marks

Noise certification procedures were developed by the International Civil Aviation Organization (ICAO) for light propeller driven aeroplanes (with a take off mass not exceeding 9000 kg). The established procedure following ICAO Annex 16 chapter 6 requires the aeroplane to conduct four level flyers at a height of 300 m above a microphone with a maximum continuous power setting. This procedure is now replaced by a new procedure documented in Annex 16 as chapter 10 where the aircraft must conduct six take offs with maximum continuous power and fly over a microphone positioned 2.5 km past the point of brake release. In both procedures, the maximum A weighted flyover noise level is to be compared to an (aircraft mass dependent) noise limit; however, both procedures have different noise limits. A study was conducted where 10 propeller driven aeroplanes were measured according to both chapter 6 and chapter 10 in order to evaluate the relative practicability and noise stringency of both procedures. ESA

N91-30911# Southampton Univ. (England). Inst. of Sound and Vibration Research.
POWER OUTPUT MINIMISATION AND POWER ABSORPTION IN THE ACTIVE CONTROL OF SOUND
S. J. Elliott, P. Joseph, P. A. Nelson, and M. E. Johnson Mar. 1991 40 p
(ISVR-TR-191; ETN-91-99553) Avail: NTIS HC/MF A03

Active minimization of total power output and active absorption of sound power are analyzed, using a general impedance based approach, for an array of controllable secondary sources and an array of original primary sources. When the total power output of the two arrays is minimized, and the primary source array is all in phase, the power output of each of the secondary sources is found to be exactly zero. When the power absorption of the secondary source array is maximized, the net power output of the

primary source array can either be reduced or increased, compared to that in the absence of control, depending on the properties of the transfer impedances. If the primary and secondary sources are well coupled (as is the case when they are spaced less than a quarter wavelength apart in free space or when they are in an enclosure excited near the natural frequency of a lightly damped mode) minimizing the total power output gives worthwhile reductions in the radiated power of the primary source. Maximizing the power absorption of the secondary source under these conditions, however, can considerably increase the power output of the primary source. If the sources are well separated, compared with the wavelength, in the free field, or are placed in a diffuse sound field in an enclosure, the coupling between the sources is weak. Under these conditions the secondary source can effect little reduction in the power output of the primary source. Although acoustic power can still be absorbed by the secondary source under such circumstances, the amount of absorbed power will always be small compared with the power output of the primary source. ESA

72 ATOMIC AND MOLECULAR PHYSICS

Includes atomic structure, electron properties, and molecular spectra.

N91-30912# California Univ., Berkeley.
NEUTRAL ATOM DEBROGLIE-WAVE INTERFEROMETRY Quarterly Report No. 3, Aug. - Oct. 1990
John F. Clauser 14 Nov. 1990 21 p
(Contract N00014-90-J-1475)
(AD-A229368) Avail: NTIS HC/MF A03 CSCL 13/9

A brief summary is provided of vibration isolation techniques and their application to neutral atom interferometry experiments. Naturally, the difficulty in achieving acceptable vibration isolation for any given experiment depends largely upon the noise sensitivity of the experiment. Since neutral atom interferometers may be configured to act as ultra-sensitive inertial sensors, their vibrational noise sensitivity is inherently high. GRA

N91-30913# Aerospace Corp., El Segundo, CA. Lab. Operations.
DIRECT OBSERVATION OF NF(X) USING LASER INDUCED FLUORESCENCE: DETERMINATION OF H + NF2 BRANCHING RATIO
Raymond F. Heidner, III, Henry Helvajian, John S. Holloway, and John B. Koffend 30 Sep. 1990 29 p
(Contract F04701-88-C-0089)
(AD-A229444; TR-0090(5930-04)-2; SSD-TR-90-28) Avail: NTIS HC/MF A03 CSCL 09/3

For the first time, the branching ratio for the H + NF2 has been measured using direct detection of the excited NF(a 1 Delta) and the ground NF(X 3 Sigma -) states. NF(a 1 Delta) was observed by its emission at 874 nm from both the 249 nm photolysis of NF2 and from the reaction of H atoms (produced from HBr photolysis at 193 nm) with NF2. While NF(X 3 Sigma -) was easily detected by laser induced fluorescence on the NF b 1 Sigma - X 3 Sigma - transition following 249 nm NF2 photolysis, it was not observed following the H + NF2 reaction. This result leads to a lower limit for the NF(a) branching ratio, NF(a)/NF(sub tot) greater than 0.90 +/- 0.03, in accord with previous results. The measured NF(a 1 Delta) quantum yield from KrF photolysis of NF2, Phi(sub NF(a)) less than 0.04 +/- 0.02 also agrees with prior work. The NF2 photolysis quantum yield is observed to be unity, based on results from an HCl titration of the F atoms from the 249 nm photolysis of NF2. GRA

N91-30914# Wayne State Univ., Detroit, MI. Dept. of Physics and Astronomy.
THEORETICAL INVESTIGATIONS OF NEGATIVE IONS IN A HYDROGEN SOURCE Final Report, 1 Sep. 1987 - 31 Aug. 1990
Jogindra Wadehra 31 Aug. 1990 102 p
(Grant AF-AFOSR-0342-87)
(AD-A229486; AFOSR-90-1138TR) Avail: NTIS HC/MF A06 CSCL 20/5

The principal results of the research are two-fold. First, the time-dependent behavior of electron swarms in various atomic and molecular gases were obtained using a novel numerical procedure. The electrons injected in the gaseous source excite and ionize the atoms as well as molecules and, more importantly, cause dissociation and vibrational excitation of the molecular species. Second, the cross sections and the rates of negative ion production via the process of dissociative electron attachment to various light molecules were calculated. The role played by initial rovibrational excitation of the molecule in enhancing the rates of production of negative ion beams were investigated in detail. Since the processes of dissociative attachment and vibrational excitation are complementary in nature (both proceed via the formation of an intermediate resonant anion state), we have also investigated the isotope effect for the vibrational excitation of molecular hydrogen and its five isotopes were also examined. Very useful scaling law for these excitation cross sections were for vibrational excitation or deexcitation, by electron impact, of heavier isotopes of H2 from the corresponding sections for molecular hydrogen. GRA

N91-30915# Lawrence Livermore National Lab., CA.
A NORMAL INCIDENCE X RAY MIRROR FOR 70 ANGSTROM
D. G. Stearns, R. S. Rosen, and S. P. Vernon (Vernon Applied Physics, Torrance, CA.) 23 Apr. 1991 14 p
(Contract W-7405-eng-48)
(DE91-012109; UCRL-ID-107107) Avail: NTIS HC/MF A03

Multilayer (ML) structures composed of alternating, ultrathin layers of Ru and B4C have been grown by dc magnetron sputtering. The ML microstructure has been characterized using x-ray diffraction and high-resolution transmission electron microscopy, and the normal incidence reflectivity has been measured using synchrotron radiation. It is found that, under optimum deposition conditions, the ML exhibit smooth and compositionally abrupt interfaces, with a normal incidence reflectivity as high as 20 percent at 72 A. The reflectivity decreases when the ML are annealed at 500 C due to interdiffusion and compound formation at the interfaces. DOE

N91-30916*# Fermi National Accelerator Lab., Batavia, IL.
LIMITS TO THE RADIATIVE DECAY OF THE AXION
M. Ted Ressell Jul. 1991 44 p Prepared in cooperation with Chicago Univ., IL Sponsored in part by NSF
(Grant NAGw-1340)
(NASA-CR-188702; NAS 1.26:188702; FERMILAB-Pub-91/180-A) Avail: NTIS HC/MF A03 CSCL 20H

An axion with a mass greater than 1 eV should be detectable through its decay into two photons. The astrophysical and cosmological limits which define a small window of allowed axion mass above 3 eV are discussed. A firm upper bound to the axion's mass of M(sub a) less than or equal to 8 eV is derived by considering the effect of decaying axions upon the diffuse extragalactic background radiation and the brightness of the night sky due to axions in the halo of the Milky Way galaxy. The intergalactic light of clusters of galaxies is shown to be an ideal place to search for an emission line arising from the radiative decay of axions. An unsuccessful search for this emission line in three clusters of galaxies is then detailed. Limits to the presence of any intracluster line emission are derived with the result that axions with masses between 3 and 8 eV are excluded by the data, effectively closing this window of axion mass, unless a severe cancellation of axionic decay amplitudes occurs. The intracluster flux limits are then used to constrain the amplitude of any such model dependence. Author

N91-30917# Brown Univ., Providence, RI. Engineering Div.
BASIC RESEARCH ON MACROMOLECULAR DYNAMICS Annual Report, 1 Jun. 1989 - 31 May 1990
J. H. Weiner 11 Jul. 1990 110 p
(Contract GRI-5085-260-1152)

(PB91-185033; GRI-90/0281) Avail: NTIS HC/MF A06 CSCL 20H

The widespread use of plastic pipe for gas distribution dictates the need for obtaining as thorough an understanding of the mechanical behavior of plastics as possible in order to maximize safety and economy. This behavior can be studied on the atomic scale, treating individual long-chain molecules. Research is focused on the importance of noncovalent interactions in dense macromolecular systems. Two concepts, the noncovalent bond force and the chain stress, were introduced to aid in the study of this question. The first of these is also valuable in the study of simpler molecular systems, such as the diatomic liquid where it provides a new view of the intramolecular contribution to the pressure equation. The chain stress was further studied in a new type of network model. In a stretched state, the induced anisotropy of chain-chain interaction causes the chain vector to cease to be a principal direction of the chain stress. As a probe of atomic mobility in a dense polymer network, the diffusion of small gas atoms through such systems is simulated. The results are in good qualitative agreement with the experiment. GRA

N91-30918# National Inst. of Standards and Technology, Gaithersburg, MD.
STOPPING POWER OF FAST CHARGED PARTICLES IN HEAVY ELEMENTS
H. Bichsel Apr. 1991 74 p Prepared in cooperation with Bichsel (Hans), Seattle, WA
(PB91-194399; NISTIR-4550) Avail: NTIS HC/MF A04 CSCL 20H

The stopping power from Bethe's theory contains terms which are known only approximately and must be estimated with the use of experimental data. These terms include a material constant, the mean excitation energy of the medium, and the shell-, Bloch- and Barkas-corrections. In an analysis of measured proton and alpha-particle stopping powers and ranges, modifying parameters were introduced into these corrections, and the mean excitation energy was simultaneously adjusted, so as to get the closest possible agreement with experimental results. Such an analysis is reported for elements with atomic numbers Z equal or greater than 57. The modification parameters introduced for the shell corrections have a simple relation to atomic energy levels. The Bethe theory with the adopted mean excitation energies and proposed adjustments of the shell- and Burkas-corrections predicts stopping powers that are in close agreement with experimental values, within the experimental uncertainties. Author

N91-30919# California Univ., Berkeley. Lawrence Berkeley Lab.
TUNABLE FAR INFRARED LASER SPECTROSCOPY OF VAN DER WAALS MOLECULES IN A PLANAR SUPERSONIC JET EXPANSION Ph.D. Thesis
Kerry Lynn Busarow Dec. 1990 317 p
(Contract DE-AC03-76SF-00098)
(DE91-014319; LBL-30074) Avail: NTIS HC/MF A14

The gas phase high resolution spectroscopic study of weakly bound clusters can provide the information necessary to develop an intermolecular potential energy surface. This surface can then be used to better understand condensed phases. In this work, a tunable far infrared laser spectrometer is used to study weakly bound dimers produced in the newly developed continuous planar supersonic jet expansion apparatus. The water dimer is an extensively studied hydrogen bonded dimer. It undergoes several tunneling motions which result in splittings and perturbations of the rovibrational energy levels. A review is presented of much of the experimental and theoretical work done on water dimer, including a description of the combined fit of all the high resolution spectroscopic results by Coudert and Hougen. Also included is a discussion of the measurement of the K = 1 lower (yields) K = 2 lower band performed using the tunable far infrared laser/planar jet apparatus. The preliminary results from the study of CH4 center dot H2O will also be presented. CH4 center dot H2O is unique in that, unlike a strongly anisotropic complex, such as the water dimer, the monomer subunits are nearly free internal rotors. Seven bands are observed which have very similar band origins and rotational constants. Two energy level diagrams are proposed which are strongly influenced by earlier ArH2O studies. A brief qualitative discussion of the CH4 center dot H2O binding energy compared to that of ArH2O is also included. DOE

N91-30920# Oak Ridge National Lab., TN.
DESIGN ASPECTS FOR A PULSED-MODE, HIGH INTENSITY, HEAVY NEGATIVE ION SOURCE
G. D. Alton 1990 5 p Presented at the 2nd European Particle Accelerator Conference, Nice, France, 11-16 Jun. 1990
(Contract DE-AC05-84OR-21400)
(DE90-012205; CONF-900603-5) Avail: NTIS HC/MF A01

A high intensity, plasma sputter, negative ion source, which uses multi-cusp, magnetic field, plasma confinement techniques, was designed. The source is an axial geometry version of the radial geometry source which has demonstrated pulsed mode peak intensity levels of several mA for a wide spectrum of heavy negative ion species. The mechanical design features include provisions for fast interchange of sputter samples, ease of maintenance, direct cooling of the discharge chamber, and the use of easily replaced coaxial LaB6 cathodes. Author

N91-30921# Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H., Vienna. Hauptabt. Industrielle Messtechnik.
THE INDUSTRIAL APPLICATION OF RADIATION SOURCES
Erich Frevert Jan. 1991 11 p In GERMAN; ENGLISH summary Presented at Strahlenschutz-Sonderkurs fuer Referenten des Oesterrichischen Zivilschutzverbandes, 20-23 Nov. 1990
(OEFZS-4566; ETN-91-99497) Copyright Avail: NTIS HC/MF A03

The two main fields of the industrial application of radioisotopes are introduced. Transmission and backscattering methods are reported in the field of production control scheme. X-ray fluorescence and neutron moisture gaging are mentioned, as well as depth of charge measurement. Flow and intermixture measurements are described in the field of tracer investigations. Boundary surface processes are examined. The determination of the precise location of nonmetallic pipe lines is mentioned as an application. ESA

N91-30922# Stockholm Univ. (Sweden). Dept. of Physics.
ON THE K-X AND M-X BAND SYSTEMS OF ThO
G. Edvinsson and J. Jonsson Jan. 1991 30 p
(USIP-91-01; ETN-91-99499) Avail: NTIS HC/MF A03

The band systems K-X and M-X in the spectrum of ThO are reinvestigated. The K and M states are excited Omega = 1 states and the X state is the ground state with Omega = 0(+). The first analysis of these band systems is confirmed and extended. Three new bands are found and rotationally analyzed. Homogenous perturbations between the K and the M states are studied. The vibrational level v = 3 of the ground state is analyzed for the first time. Equilibrium constants for the ground state are determined from 11 bands. Wave numbers of all analyzed lines, not published before, are given. ESA

N91-30923# Rutherford High Energy Lab., Chilton (England).
PROSPECTS FOR RELIC NEUTRINO DETECTION
P. F. Smith Mar. 1991 17 p Presented at Astroparticle Physics Workshop, Santa Monica, CA, 28-30 Nov. 1990, and Texas/ESO-CERN Conference, Brighton, England, 17-12 Dec. 1990
(RAL-91-017; ETN-91-99556) Avail: NTIS HC/MF A03

The difficulties and obstacles that have so far precluded any realistic proposal for neutrino detection are illustrated by summarizing six detection ideas which have previously been considered. In each case the problems which have prevented the idea being developed into an experimental proposal are indicated. The most promising direction for further study appears to be that of coherent interactions, from which a considerably increased cross section results for scattering from bulk matter, producing small macroscopic forces. So far, no investigations of this idea have resulted in a practical detection scheme, but one new variation is

suggested which could in principle give an observable effect, if the necessary stringent experimental conditions could be created. It is suggested that this may become possible with the aid of foreseeable 21st century developments in nanotechnology. ESA

N91-30924# Argonne National Lab., IL. High Energy Physics Div.
DIRECT PHOTON PRODUCTION IN POLARIZED PP COLLISIONS
E. L. Berger and J. Qiu (State Univ. of New York, Stony Brook.) Jan. 1991 9 p Presented at the Polarized Collider Workshop, University Park, PA, 15-17 Nov. 1990
(Contract W-31-109-eng-38)
(DE91-008728; ANL-HEP-CP-91-01; CONF-9011177-6; ITP-SB-90-102) Avail: NTIS HC/MF A02

We argue that inclusive direct photon production at large transverse momentum in proton-proton interactions with longitudinally polarized beam and target is an incisive probe of the polarized gluon distribution in a proton. We provide predictions of cross sections of range of reasonable choices of the polarized gluon distribution. At current fixed target energies, the cross sections are small but measurable. At collider energies, such as the SSC energy, isolated direct photon production should be considered in order to minimize the nonperturbative contribution due to fragmentation. DOE

73 NUCLEAR AND HIGH-ENERGY PHYSICS

Includes elementary and nuclear particles; and reactor theory.
For space radiation see *93 Space Radiation.*

N91-30925 McMaster Univ., Hamilton (Ontario). Accelerator Lab.
A FEASIBILITY STUDY FOR CONSTRUCTION OF A DEDICATED ON-LINE SEU BEAM FACILITY AT THE MCMASTER UNIVERSITY TANDEM VAN DE GRAAFF ACCELERATOR
James C. Waddington, James W. Stark, and David M. Tucker 1989 36 p
(Contract DREO-W7714-8-5786)
(CTN-91-60180) Avail: NTIS HC A03

In order to reproduce the radiation environment likely to be encountered by space-based electronic systems, high energy, high linear energy transfer (LET) particles which can cause single event upset (SEU) must be produced. A tandem Van de Graaff accelerator is ideal for this purpose. This report describes preliminary work done at McMaster University in Hamilton, Ontario, in which the possible accelerator produced beams were compared with these known LET distributions. The findings indicate that almost all of this distribution can be simulated, and a world-class facility could be set up at McMaster. Preliminary work on associated electronic and beam monitoring equipment is also described.
Author (CISTI)

74 OPTICS

Includes light phenomena; and optical devices.
For lasers see *36 Lasers and Masers.*

N91-30926# State Univ. of New York, Buffalo. Dept. of Chemistry.
OPTICAL (HYPER) POLARIZABILITIES OF SMALL SILICON CLUSTERS
Tapio T. Rantala, Mark I. Stockman, Daniel A. Jelski, and Thomas F. George Nov. 1990 9 p
(Contract N00014-90-J-1193)
(AD-A229383; UBUFFALO/DC/90/TR-29) Avail: NTIS HC/MF A02 CSCL 07/4

Electronic contributions to the optical (hyper)polarizabilities of small silicon clusters are theoretically determined. Geometries and the electronic structures of the clusters are established using the tight binding model. The nonlinear polarizabilities are found to depend primarily on the symmetry of the cluster and prove to be high for the low symmetry clusters. Possible experiments and applications are discussed. GRA

N91-30927# Los Alamos National Lab., NM.
MEASUREMENT OF MOLYBDENUM MIRROR REFLECTIVITIES
R. L. Blake, J. C. Davis, P. P. Gong, D. E. Graessle, and W. Rudderman (INRAD, Inc., Northvale, NJ.) 1991 11 p Presented at the Society of Photo-Optical Instrumentation Engineers (SPIE) Meeting, San Diego, 21-26 Jul. 1991
(Contract W-7405-eng-36)
(DE91-013318; LA-UR-91-1837; CONF-9107115-2) Avail: NTIS HC/MF A03

The reflectivity versus angle for a variety of molybdenum mirrors has been measured for both hard and soft x-rays in an attempt to deduce any variation in performance between single crystal, polycrystalline, and evaporated mirrors. A filling technique has been used to arrive at the roughness of the mirrors. An approach to utilize such measurements to characterize mirrors and derive low energy optical constants or many elements is outlined. DOE

N91-30928 Tel-Aviv Univ. (Israel). Dept. of Electron Devices and Materials and Electromagnetic Radiation.
Ge-Sn-Se, Ge-Se-Te, AND Ge-Sn-Se-Te GLASSES FOR INFRA-RED OPTICAL FIBERS M.S. Thesis
Idit Haruvi-Busnach Nov. 1989 127 p In HEBREW; ENGLISH summary
(ITN-91-85148) Copyright Avail: Tel-Aviv Univ., Exact Sciences Library, Ramat Aviv 69978, Israel

Chalcogenide glasses of the Ge-Sn-Se, Ge-Se-Te and Ge-Sn-Se-Te systems were studied, to determine suitable compositions for mid-infrared optical fibers, especially for CO2 laser radiation. The main aims were to improve the transmission of Ge-Se glasses at 10.6 micron, by reducing energy losses due to multiphoton absorption, and to eliminate the Ge-O absorption peak at about 13.5 micron, which usually appears in Ge-Se glasses. To this end, Ge and Se atoms were partially replaced by heavier Sn and Te atoms, which increase the reduced mass and shift the multiphoton absorption edge to longer wavelengths. The infrared (IR) high transparency region of Ge-Se-Sn, Ge-Se-Te and Ge-Sn-Se-Te glasses was expanded by 1 to 2 microns toward longer wavelengths, compared with Ge-Se glasses, mainly for glasses containing up to 70 atomic percent of Se. The mechanical and optical characteristics of the glasses were related to their structures. The addition of Te atoms increased the intensity of the impurity absorption peak of Ge-O in Ge-Se-Te glasses. Unlike Te, Sn acts as a trapping agent, to which oxygen preferably bonds, and reduces or eliminates the Ge-O peak in Ge-Sn-Se-Te glasses. The glass transition temperature and microhardness of most examples of Ge-Se-Sn, Ge-Se-Te and Ge-Sn-Se-Te glasses were less than those of Ge-Se glasses, indicating a weakening of the glass structure. The stable glasses, which are not crystallized during any heating process, are suitable for fiber drawing. The best fibers had an attenuation of 20 dB per meter at 10.6 micron, and a maximum transmitted power density of 2,400,000 W per sq m. Extrinsic losses such as the Ge-O impurity peak and scattering losses prevented the production of fibers with lower attenuation.
ISA

N91-30929 Department of the Navy, Washington, DC.
PLANAR FIBER-OPTIC INTERFEROMETER ACOUSTIC SENSOR Patent
Nicholas Lagakos and Joseph A. Bucaro, inventors (to Navy) 19 Feb. 1991 12 p Filed 1 Sep. 89
(AD-D014922; US-Patent-4,994,668; US-Patent-Appl-SN-402174; US-Patent-Class-250-227.19) Avail: US Patent and Trademark Office CSCL 17/1

A sensing portion for an interferometric acousto-optic sensor and a sensor using that sensing fiber are disclosed. The sensor fiber has an outer coating of a material having a low bulk modulus.

This coating greatly enhances the sensitivity of the sensor fiber. In a preferred embodiment, the material of low bulk modulus embeds the sensor fiber and any included reference fiber. Most preferably, the material having a low bulk modulus is a polymer such as polyurethane. The sensing portions made according to the present invention will usually be incorporated into sensors used for underwater exploration. GRA

N91-30930 Department of the Navy, Washington, DC.
OPTICAL COMMUNICATION SYSTEM HAVING A WIDE-CORE SINGLE-MODE PLANAR WAVEGUIDE Patent
Arthur K. Jordan, inventor (to Navy) and S. Lakshmanasamy, inventor (to Navy) 9 Oct. 1990 16 p Filed 5 Jun. 89
(AD-D014927; US-Patent-4,961,618; US-Patent-Appl-SN-361078; US-Patent-Class-350-96.12) Avail: US Patent and Trademark Office CSCL 25/5

This invention relates to an improved optical communication system having an enhanced wide-core single-mode planar waveguide for transmitting a single-mode light wave in a unique manner. The system is generally made up of light-wave source means, the aforementioned waveguide and receiving means. The waveguide is generally made up of an inhomogeneous wide-core means of block-like configuration and opposed cladding means where one set of opposed sides of the waveguide are provided with the cladding means. The cladding means has a constant permittivity. The core means has an inhomogeneous permittivity profile, a part of which is greater than the cladding means permittivity and another part of which is less than the cladding means permittivity. The analogy of quantum mechanics with optics can provide an algorithm for an equivalent inhomogeneous quantum potential formula of curvilinear shape. GRA

N91-30931*# Alabama Univ., Huntsville.
DEVELOPMENT OF A STABLE ELECTRO-OPTICAL MODULATOR Final Report, 14 Feb. 1990 - 13 Jun. 1991
Mustafa A. G. Abushagur and Nathan Wilkins 15 Aug. 1991 18 p
(Contract NAS8-36955)
(NASA-CR-188757; NAS 1.26:188757) Avail: NTIS HC/MF A03 CSCL 20F

The electrical/optical characteristics of longitudinal KD*P (KD2PO4) modulators were studied to determine what physical construction would be best for use in the MSFC (Marshall Space Flight Center) vector magnetograph. Obtaining high quality KD*P modulators that could withstand the DC modulation requirement of the MSFC vector magnetograph has, in the past, been at best a game of chance. A study is summarized which investigated problems that were seen in these devices and the conclusions that were reached are presented. Author

N91-30932# European Space Agency, Paris (France).
APPLICATION OF WAVEFRONT SENSING TECHNIQUES TO RESTORING OF IMAGES DEGRADED BY ATMOSPHERIC TURBULENCE Ph.D. Thesis - Paris-Sud Univ., 1989
Jerome Primot (Office National d'Etudes et de Recherches Aerospatiales, Paris, France) May 1991 264 p Transl. into ENGLISH of Application des Techniques d'Analyse de Surface d'Onde a la Restauration d'Images Degradees par la Turbulence Atmospherique (Paris, France, ONERA), 1989 210 p Original language document was announced as N90-19168
(ESA-TT-1194; ONERA-P-1989-1; ETN-91-99796) Avail: NTIS HC/MF A12

The angular resolution of large terrestrial telescopes is essentially limited to approximately one arc second by atmospheric turbulence, regardless of the diameter of the entrance pupil. Various techniques for postprocessing images recorded at the output of the telescope have already been suggested so as to recover its theoretical resolving power. The originality of the method described here resides in the fact that data from the pupil and focal planes are processed simultaneously. To do this, a second wavefront sensing channel is placed in parallel with the conventional degraded image recording channel. It then permits continuous evaluation of the optical transfer function. From this information, the spatial frequencies of the object which were not totally masked by the turbulence can be corrected. The complete processsing of a set of (image, associated transfer function) pairs is described. The limits of the method are characterized and it was possible to carry out a laboratory experiment so as to prove its efficiency. The signal to noise ratio evaluated for this technique allowed it to be placed with respect to the techniques of speckly interferometry and interferometry in pupil plane for various luminance levels of the observed object. ESA

N91-30933# Laboratoire d'Automatique et d'Analyse des Systemes, Toulouse (France).
MOTION VISION FOR MOBILE ROBOTS Ph.D. Thesis - Toulouse Univ.
Matthieu Herrb 1991 127 p In FRENCH; ENGLISH summary
(LAAS-91048; ETN-91-99472) Avail: NTIS HC/MF A07

The problem of using computer vision in mobile robots is dealt with. The datacube specialized cards and a parallel machine using a transputer network are studied. The tracking and localization of a three dimensional object in a sequence of images is examined, using first order prediction of the motion in the image plane and verification by a maximal clique search in the graph of mutually compatible matchings. A dynamic environment modeling module, using numerical fusion between trinocular stereovision and tracking of stereo matched primitives is presented. The integration of this perception system in the control architecture of a mobile robot is examined to achieve various functions, such as vision servo motion and environment modeling. The functional units implementing vision tasks and the data exchanged with other units are outlined. Experiments realized with the mobile robot Hilare 1.5 allowed the proposed algorithms and concepts to be validated. ESA

75 PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion.

For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

N91-30934# California Univ., San Diego, La Jolla. Dept. of Mathematics.
NONLINEAR STABILITY IN FLUIDS AND PLASMA DYNAMICS-CONFORMAL QUASI-CONFORMAL GEOMETRY: ITERATION, DISTORATION, DYNAMICS, AND CIRCLE PACKING Final Report, 15 Aug. 1987 - 29 Sep. 1990
Burt Rodin, Michael Freedman, Herbert Levine, and Henry Arbarbanel 1 Oct. 1990 11 p
(Contract F49620-87-C-0117)
(AD-A229469; AFOSR-90-1157TR) Avail: NTIS HC/MF A03 CSCL 20/3

The following subject areas are covered: topology and magnetic energy in incompressible perfectly conducting fluids; links of tori and the energy of incompressible flows; factoring the logarithmic spiral; inherent differentiability; a power law for the distortion of planar sets; strange actions of groups on spheres; solving Beltrami equations by circle packing; an estimate for hexagonal circle packings; the convergence of circle packings to the Riemann mapping; Schwarz's lemma for circle packings; an extremal region for harmonic measure; Schwarz's lemma for circle packings; Thurston's proof of Andreev's theorem; an inverse problem for circle packing approximations to the Riemann mapping function; circle packing and conformal mapping; circle packing and Riemann surfaces; a problem of A. Beardon and K. Stephenson; canonical conformal mapping for a multiply connected domain by Thurstons's circle packing method. GRA

N91-30935# Air Force Weapons Lab., Kirtland AFB, NM.
AN ANALYTIC MODEL FOR THE COMPRESSION OF PLASMA TOROIDS Final Report, Jul. - Sep. 1990
Carl R. Sovinec Oct. 1990 22 p
(AF Proj. 5797)
(AD-A229500; WL-TR-90-69) Avail: NTIS HC/MF A03 CSCL 20/9

An expression for the energy required to compress a plasma toroid in the MARAUDER experiment has been derived. The analysis assumes that the plasma follows the ideal magnetohydrodynamics approximation, that the magnetic forces are the only ones of interest, and that the toroid is in a confined equilibrium at the start and end of the compression. All dimensions of the toroid are force to collapse linearly, and the magnetic energy in the toroid is found to be inversely proportional to the inner radius - or any other dimension. This analysis gives an estimate to help limit the parameter space of a computational study of the compression process. GRA

N91-30936 Queens Univ., Belfast (Northern Ireland).
STUDIES OF LASER-GENERATED PLASMAS RELEVANT TO SOFT X-RAY LASER RESEARCH Ph.D. Thesis
Richard Ewing Corbett 1987 225 p
Avail: Univ. Microfilms Order No. BRDX91839

Studies related to two different schemes for producing laser action in the X-VUV spectral region using highly ionized laser generated plasmas as the amplifying media are discussed. The sodium-neon scheme involves the pumping of the 1s (exp 2) (1)S-s4p (1)P transition at 11.000A in NeIX by radiation from the 1s (exp 2) (1)S-1s2p (1)P transition at 11.000A in NaX, to give population inversions on the 2-4, 3-4, and 2-3 singlet transitions of NeIX at 58, 230, and 82 A respectively. The methods employed to investigate the properties of the plasmas and the results are presented. The other scheme considered is one that relies for its operation on the recombination dynamics of a fully ionized plasma. Such plasmas were generated by line focus laser irradiation of thin carbon fibers. Finally, developmental work on an interesting technique for investigating the distribution of ions of a particular species in a coronal plasma is described. This technique uses 1 to 2 keV radiation from an intense quasi point source backlighting plasma to probe an extended plasma containing ion species which absorb the black light radiation at wavelengths corresponding to the resonance transitions of the ions. Dissert. Abstr.

N91-30937 Michigan Univ., Ann Arbor.
MODELING X-RAY LASER GAIN IN RECOMBINING PLASMAS Ph.D. Thesis
David Francis Roelant 1990 215 p
Avail: Univ. Microfilms Order No. DA9116287

Optimal conditions for lasing in H-like and Li-like aluminum as well as in He-like silicon are examined in the context of recombining plasmas. Simulations are carried out for the free expansion of initially hot, dense, and thin cylinders of aluminum and silicon plasmas. Conditions generated from these simulations are input into a simple gain model, yielding information on the state of the plasma variables which maximizes the gain coefficient of a particular lasing transition. The scaling of the maximum gain coefficient with the initial plasma diameter and with the ratio of lasant ions to coolant ions is done for the 3d-2p singlet to singlet transition in helium-like silicon. The theoretical theory and numerical aspects of the principal components of plasma modeling, namely ionization dynamics (ID), magnetohydrodynamics (MHD), and radiative transfer (RT) are presented. The MHD algorithm uses a two temperature Lagrangian gridding method. The ID algorithm utilizes the Collisional-Radiative (CR) model and can integrate all level populations with a stiff differential equation solver or solve by matrix inversion when CR equilibrium is valid. The atomic processes include dielectronic recombination, photoexcitation, photoionization, collisional excitation and de-excitation, three-body and radiative recombination, collisional ionization, and radiative decay. An escape probability formalism is used for the transfer of bound-bound, bound-free, and free-free radiation in the RT model. Dissert. Abstr.

N91-30938# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
ACTIVITIES REPORT ON THE EXPERIMENTAL STUDY OF PARTICLE DIFFUSION IN SUPERFICIALLY CONFINED PLASMA FOR MULTIDIPOLAR MAGNETIC FIELDS [RELATORIO DE ATIVIDADES DO PROJETO DE ESTUDO EXPERIMENTAL DA DIFUSAO DE PARTICULAS EM PLASMA CONFINADO SUPERFICIALMENTE POR CAMPOS MULTIDIPOLO MAGNETICOS]
J. L. Ferreira, W. C. Damasio, J. G. Ferreira, G. M. Sandonato, M. V. Alves, A. Montes, and G. O. Ludwig 28 Dec. 1990 52 p In PORTUGESE
(INPE-5228-RPE/644) Avail: NTIS HC/MF A04

The study of the diffusion of charged particles across magnetic fields is fundamental to the understanding of the transportation process in plasmas. An experimental study of the diffusion coefficient of electrons diffused through a magnetic barrier in the interior of the PQUI-I machine is discussed. A system of data acquisition is used which allows measurements to be taken with a machine operating in a continuous regime. Results show that the electron diffusion coefficient is well above the classic diffusion coefficient. The experimental values measured with various types of electrostatic probes are in fact closer to the values calculated from the Bohm diffusion coefficient anomaly. Author

N91-30939# Technische Univ., Berlin (Germany, F.R.). Fachbereich Physik.
DEVELOPMENT OF A METHOD FOR QUANTITATIVE DETERMINATION OF PHOTON EMISSIONS OF X RAY SOURCES AND THEIR UTILIZATION IN LASER PRODUCED CARBON AND IRON PLASMAS Ph.D. Thesis [ENTWICKLUNG EINER METHODE ZUR QUANTITATIVEN BESTIMMUNG DER PHOTONENEMISSION VON ROENTGENQUELLEN UND IHRE ANWENDUNG AUF LASERERZEUGTE KOHLENSTOFF- UND EISEN-PLASMEN]
Reiner Thornagel 1990 100 p In GERMAN
(ETN-91-99444) Avail: NTIS HC/MF A05

A measuring device of source calibration was developed and built for the spectral field of non penetrating X-ray radiation from 250 to 1800 eV in a radiometric laboratory. A method was obtained for the calibration of line and continuous radiation sources by comparison with synchrotron radiation BESSY, as a primary radiation standard. The measuring device is described, by which radiation of carbon and iron lasers are examined. The carbon plasma showed a spectrum with few lines of high intensity and a soft continuum radiation. The iron plasma delivered a multilined spectrum in a 720 to 100 eV photon energy field, which is, for example, of interest for X-ray lithography. ESA

N91-30940# Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H., Vienna. Engineering Energie- und Anlagentechnik.
EXAMINATIONS OF THERMAL CONDUCTIVITY IN DENSE PLASMA [UNTERSUCHUNGEN UEBER WAERMELEITUNG IN DICHTEN PLASMEN]
Gerald Kamelander, Gert Sdouz, and Franz Woloch Dec. 1990 67 p In GERMAN Sponsored by Fonds zur Foerderung der Wissenschaftlichen Forschung
(OEFZS-4564; ETN-91-99495) Copyright Avail: NTIS HC/MF A04

A computer program was developed for the simulation of microdetonations, such as those which occur in inertial fusion. This program is to be considered as an extension of the conventional MEDUSA code. Three options were chosen for the modelization of electron conductivity: the Spitzer model, the Rozmus Offenberger model and the Lee More model, which is the most efficient for dense plasmas, from a physical point of view. The Spitzer model and the Rozmus Offenberger model gave the same results, which were different from those of the Lee More model. These two models also give good results for fusion effect and energy liberation. ESA

N91-30941# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics.
THE DYNAMIC RESPONSE OF AN INHOMOGENEOUS PLASMA DIODE TO AN APPLIED ELECTRIC FIELD
M. Bohm and S. Torven Aug. 1990 32 p
(TRITA-EPP-90-05; ISSN-0348-7539; ETN-91-99501) Avail: NTIS HC/MF A03

Q machine and triple plasma machine experiments show that a suddenly applied voltage drop may either be supported by a cathode sheath or by a quasilinear potential variation over the plasma lasting for several electron transit times. In the latter case an ion density cavity existed initially. An analytical model and numerical simulations are used to show that a cavity gives rise to a quasilinear potential variation similar to the one observed experimentally for applied voltage drops below a certain critical value which depends on the cavity depth. For larger values the drop concentrates to a cathode sheath. The quasilinear profile steepens to a double layer formed close to the density minimum for large cavity depths. The theoretical potential profiles are obtained by assuming a stationary electron motion after an electron transit time and quasineutrality in the ion density cavity. ESA

N91-30942# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics.
DYNAMIC TRAPPING OF ELECTRONS IN THE PORCUPINE IONOSPHERIC ION BEAM EXPERIMENT
M. Bohm, N. Brenning, and C.-G. Faelthammar Aug. 1990 17 p Submitted for publication Sponsored by Swedish Natural Science Research Council and Swedish National Board for Space Activities
(TRITA-EPP-90-06; ISSN-0348-7539; ETN-91-99502) Avail: NTIS HC/MF A03

Electrons are needed to maintain quasineutrality in a case where positive ions are injected across the magnetic field into a limited volume in a magnetized plasma. In the abscence of collisions, a positive potential builds up and traps the electrons which enter the region along the magnetic field. If the added density of ions exceeds the ambient density, large potential differences along the magnetic field can be maintained this way. The process explains several features of the Porcupine xenon ion beam injection experiment, where strong magnetic field aligned electric fields were measured in the vicinity of a xenon ion beam which was injected into the ambient ionosphere from a spinning sub payload. ESA

N91-30943*# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics.
THE COLLECTIVE GYRATION OF A HEAVY ION CLOUD IN A MAGNETIZED PLASMA
N. Brenning, C. Swenson, M. C. Kelley, J. Providakes, and R. Torbert (New Hampshire Univ., Durham.) Sep. 1990 30 p Presented at COSPAR Plenary Meeting, 1990 Submitted for publication Sponsored by NASA, Washington, DC; Swedish Board for Space Activities; and Swedish Natural Science Research Council
(NASA-CR-187823; NAS 1.26:187823; TRITA-EPP-90-07; ISSN-0348-7539; ETN-91-99503) Avail: NTIS HC/MF A03 CSCL 20I

In both the ionospheric barium injection experiments CRIT 1 and CRIT 2, a long duration oscillation was seen with a frequency close to the gyro frequency of barium and a time duration of about one second. A model for the phenomena which was proposed for the CRIT 1 experiment is compared to the results from CRIT 2 which made a much more complete set of measurements. The model follows the motion of a low Beta ion cloud through a larger ambient plasma. The internal field of the model is close to antiparallel to the injection direction v sub i but slightly tilted towards the self polarization direction E sub p = -V sub i by B. As the ions move across the magnetic field, the space charge is continuously neutralized by magnetic field aligned electron currents from the ambient ionosphere, drawn by the divergence in the perpendicular electric field. These currents give a perturbation of the magnetic field related to the electric field perturbation by Delta E/Delta B approximately equal to V sub A. The model predictions agree quite well with the observed vector directions, field strengths, and decay times of the electric and magnetic fields in CRIT 2. The possibility to extend the model to the active region, where the ions are produces in this type of self-ionizing injection experiments, is discussed. ESA

N91-30944# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics.
AN EXTENSION OF THE BOLTZMANN RELATION TO COLLISIONLESS MAGNETIZED PLASMAS
N. Brenning, C.-G. Faelthammar, and M. Bohm Dec. 1990 10 p Sponsored by Swedish Natural Science Research Council
(TRITA-EPP-90-08; ISSN-0348-7539; ETN-91-99504) Avail: NTIS HC/MF A02

The neutralization of positive space charge is studied for density perturbations of limited spatial extent in a collision free magnetized plasma. It is found that a local density maximum gets a positive potential which depends only on the ambient electron temperature and the relative increase in density. For small density increases, below 5, the resulting relation between potential and plasma density agrees closely with the Boltzmann relation, which applies in the presence of collisons. For larger density increases, the difference from the Boltzmann relation rapidly becomes large (a factor 2 for a 50 pct. density increase, and a factor 3 for a 100 pct. density increase). The result constitutes firstly a justification for using the Boltzmann relation also in collisionless magnetized plasma, provided that the density perturbations are small, and secondly a general relation which replaces the Boltzmann relation for larger amplitude perturbations. ESA

N91-30945# Technische Univ., Eindhoven (Netherlands). Div. of Electrical Energy Systems.
PREDESIGN OF AN EXPERIMENTAL (5-10 MWT) DISK MHD FACILITY AND PROSPECTS OF COMMERCIAL (1000 MWT) MHD/STEAM SYSTEMS
P. Massee, H. A. L. deGraaf, W. J. M. Balemans, H. G. Knoopers, and H. H. J. tenKate (Universiteit Twente, Enschede, Netherlands) Oct. 1990 119 p Sponsored in part by Netherlands Technology Foundation
(EUT-90-E-243; ISBN-90-6144-243-5; ISSN-0167-9708; ETN-91-99623) Copyright Avail: NTIS HC/MF A06

An experimental disk MHD (Magneto Hydro Dynamic) facility was designed. After designing the superconducting magnet for the open cycle disk MHD generator, the warm bore of the magnet was used as a constraint in designing the closed cycle disk MHD generator. In the experimental MHD facility an enthalpy extraction of 8.7 could be obtained with a 10 MWt open cycle MHD generator and 37.0 by means of a 5 MWt closed cycle MHD generator. System studies of four commercial scale MHD/steam systems were performed. The 1000 MWt open cycle disk generator leads to the smallest coal to busbar efficiency of 42.8. The highest coal to busbar efficiency of 50.0 is obtained in a commercial system with a closed cycle disk generator. The open cycle linear MHD/steam system leads to a coal to busbar efficiency of 49.4. When the details of the heat source and the required heat exchangers are considered, it can be anticipated that the system with an open cycle linear MHD generator will have the lowest cost of electricity (fl/kWh) of the four systems. The design of the superconducting magnet system for the experimental disk facility used principles that are valid also for large commercial systems. However, verification of these principles in an actual 1000 MWt superconducting magnet design needs further investigation. ESA

N91-30946# Mississippi State Univ., Mississippi State. Diagnostic Instrumentation and Analysis Lab.
NUMERICAL FLOW SIMULATION IN THE SLAGGING STAGE OF AN MHD COAL COMBUSTOR
O. P. Norton, A. Skaggs, and C. W. Bouchillon 1991 21 p Presented at the 2nd International Symposium on Coal Combustion, Beijing, Peoples Republic of China, 7-10 Oct. 1991
(Contract DE-AC02-80ET-15601)
(DE91-009352; CONF-911020-1) Avail: NTIS HC/MF A03

MHD is a process for efficiently converting the energy in coal

into electricity. The MHD process imposes some unique conditions on the coal combustor. First, the MHD process requires an electrically conductive gas stream. This is accomplished by burning the coal at a very high temperature, approaching 3000 K, by means of oxygen enrichment, and by seeding the combustion products with an easily ionized compound such as potassium carbonate. Second, it is desirable to prevent most of the coal slag from reaching the MHD channel. This is done by separating most of the slag from the gas stream in the combustor. A design criterion for MHD coal combustors in 90 percent slag rejection. The design of magnetohydrodynamics (MHD) combustors can be greatly enhanced by examining the flow patterns in existing MHD combustors. This article presents the present results of an effort to examine these flow patterns using numerical techniques.
DOE

76 SOLID-STATE PHYSICS

Includes superconductivity.

For related information, see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

N91-30947# Army Research Office, Research Triangle Park, NC.
CHEMISTRY RELATED TO SEMICONDUCTOR GROWTH INVOLVING ORGANOMETALLICS
G. R. Husk, K. A. Jones, R. J. Paur, and J. T. Prater 11 May 1990 120 p
(AD-A229489; AROD-90803-CH-CF; AROD-90803-MS-CF) Avail: NTIS HC/MF A06 CSCL 07/3

OMVPE (OrganoMetallic Vapor-Phase Epitaxy) technology requirements for III-V compounds and chemistry related to semiconductor growth involving organometallics are discussed. The following subject areas are covered: semiconductor device requirements; Army II-VI deposition program/MOMBE (Metal Organic Molecular Beam Epitaxy) for IR detector applications; epitaxial growth of III-V's and II-VI's using organometallics; electrical device requirements; environmental and safety issues in MOVPE; quantum chemistry of vapor phase; carbon doping and selective epitaxy (tailoring growth chemistry in MOVPE); TBA/TBP precursors in GaAs and InP MOCVD; single source precursors for III-V OMCVD (OrganoMetallic Chemical Vapor Deposition) growth; alternate sources for MOMBE of AlGaAs; mechanism of incorporation of impurities and analysis of carbon contamination; growth on nonplanar and patterned substrates; CBE growth mechanisms; TriMethylamine Alane (a new robust precursor for MOMBE growth of AlGaAs); real-time determinations of OMCVD growth kinetics on GaAs by reflectance-difference spectroscopy; photoreflectance measurements; growth and doping mechanisms for HgCdTe; photoassisted CBE (Chemical Beam Epitaxy) of CdTe and HgCdTe alloys; in-situ analysis of ZnSe growth by OMCVD using X-ray scattering; biodegradation of GaAs IC chips and wafers; detailed models of compound semiconductor growth by MOCVD; gas phase probes of GaAs cluster chemistry; photodecomposition of organometallic compounds at 193 nm; manufacturing issues in MOCVD compound semiconductor technology. GRA

N91-30948# Massachusetts Inst. of Tech., Cambridge.
PATTERNED FUNCTIONALIZATION OF GOLD AND SINGLE CRYSTAL SILICON VIA PHOTOCHEMICAL REACTION OF SURFACE-CONFINED DERIVATIVES OF (eta5-C5H5)Mn(CO)3 Technical Report No. 42
Doris Kang and Mark S. Wrighton Nov. 1990 32 p
(AD-A229570) Avail: NTIS HC/MF A03 CSCL 07/4

Treatment of a single crystal Si wafer (n- or p-type, 100 face) having a thin surface SiO(x) layer with Cl3Si-(eta(sup 5)-C5H4)Mn(CO)3, I, yields the Si-confined complex (Si)-O-Si- (eta(sup 5)- C5H4)Mn(CO)3. Coverage of about a monolayer is typically achieved. Near-UV irradiation of the Si-confined tricarbonyl in L = PPh2(n-octyl) gives the surface-confined substitution product (Si)-O-Si- (eta(sup 5)- C5H4)Mn(CO)2L. The identities of the Si-confined complexes were determined by comparison of their IR CO stretching frequencies with those of (CH3)3Si- (eta(sup 5)-C5H4)Mn(CO)2L, and of the corresponding high surface area SiO2-confined species, (SiO2)-O-Si (CH3)2-(eta(sup 5)-C5H4)Mn(CO)2L (L = CO, PPh(n-octyl)). Treatment of a Au-coated Si wafer with HS(CH2)11- (eta(sup 5)- C5H4)Mn(CO)3, II, yields about a monolayer of the Au-confined complex (Au)-S(CH2)11-(eta(sup 5)- C5H4)Mn(CO)3. Near-UV irradiation of the Au-confined tricarbonyl in the presence of L = PPh2(n-octyl) yields the surface-confined substitution product (Au)-S(CH2)11- (eta(sup 5)-C5H4)MN(CO)2L. The photochemistries of surface-confined I and II differ from the photochemistries of the corresponding solution species. Patterning of the surface of a Si wafer modified with I or of Au modified with II is readily accomplished, since photosubstitution occurs only on irradiated portions of the surface. GRA

N91-30949# Materials Research Society, Pittsburg, PA.
CHEMISTRY AND DEFECTS IN SEMICONDUCTOR HETEROSTRUCTURES, VOLUME 148 Final Report, 2 May 1989 - 1 May 1990
Joan B. Ballance, Mitsuo Kawabe, Timothy D. Sands, Eicke R. Weber, and R. S. Williams 1 May 1990 483 p Proceedings of the Materials Research Society Symposium, San Diego, CA, 24-27 Apr. 1989
(Grant AF-AFOSR-0388-89)
(AD-A229585; AFOSR-90-1053TR) Avail: NTIS HC/MF A21 CSCL 09/1

The intention of the editors was to bring together an interdisciplinary and international group of researchers working on various aspects of semiconductor heterostructures so that we could all learn from each other. In particular, we hoped to forge new links between those who study chemical interactions at heterostructure interfaces and those who are concerned with the effects of interfacial defects on the electrical and optical properties of semiconductor structures. The fact that there must be some relationship between chemical reactivity and defect formation has long been recognized, but as yet there is no detailed understanding of the actual mechanisms involved. Scientists studying either the causes or the effects of interfacial defects must appreciate all the issues and work closely with each other. Only through such collaboration can the formation of semiconductor interfaces be truly understood and, enventually, their properties controlled. If this Symposium and the resulting book have stimulated only a few such interactions, then we feel that our efforts have been successful. GRA

N91-30950# Materials Research Society, Pittsburg, PA.
GROWTH, CHARACTERIZATION AND PROPERTIES OF ULTRATHIN MAGNETIC FILMS AND MULTILAYERS, VOLUME 151 Final Report, 2 May 1989 - 1 May 1990
Joan B. Ballance, Berend T. Jonker, ed., Joseph P. Heremans, ed., and Ernesto L. Marinaro, ed. 1 May 1990 318 p Proceedings of the Materials Research Society Symposium, San Diego, CA, 25-28 Apr. 1989
(Grant AF-AFOSR-0388-89)
(AD-A229586; AFOSR-90-1060TR) Avail: NTIS HC/MF A14 CSCL 20/2

This symposium comprised 11 invited talks and 42 contributed papers, ran over 3 1/2 days, and provided a unique and interactive forum in which recent advances in low dimensional magnetism, diluted magnetic semiconductors, epitaxial overlayers and the utilization of in-situ and ex-situ techniques to characterize their microstructure, electronic and magnetic properties were discussed. The study and growth of ultrathin magnetic structures is a rapidly expanding field of materials research whose growth is synergistically driven by an increasing appreciation of the degree to which the magnetic properties depend on interfacial processes, and by the utilization of growth techniques which permit the fabrication of multilayer structures with novel electronic and magnetic properties. Equally important is the fact that atomic level control of the microstructure of these layers offers new opportunities to elucidate the physics of magnetism and to rigorously test theoretical models. GRA

N91-30951# Materials Research Society, Pittsburg, PA.
PROPERTIES OF II-VI SEMICONDUCTORS: BULK CRYSTALS, EPITAXIAL FILMS, QUANTUM WELL STRUCTURES, AND DILUTE MAGNETIC SYSTEMS, VOLUME 161 Final Report, 22 Nov. 1989 - 21 Nov. 1990
Joan B. Ballance, F. J. Bartoli, Jr., H. F. Schaake, and J. F. Schetzina 21 Nov. 1990 538 p Proceedings of the Materials Research Society Symposium, Boston, MA, 27 Nov. - 2 Dec. 1989
(Grant AF-AFOSR-0081-90)
(AD-A229589; AFOSR-90-1052TR) Avail: NTIS HC/MF A23 CSCL 09/1

The II-VI compound semiconductors possess characteristics which, as a group, are unique. Among the most active areas of investigation in these materials today are blue light emitters based on ZnSe, infrared detectors based on mercury-containing compounds such as HgCdTe, and the properties of dilute magnetic semiconductors. Each of these areas is represented by several papers included in this volume. GRA

N91-30952# Materials Research Society, Pittsburg, PA.
IMPURITIES, DEFECTS AND DIFFUSION IN SEMICONDUCTORS: BULK AND LAYERED STRUCTURES, VOLUME 163 Final Report, 22 Nov. 1989 - 21 Nov. 1990
Joan B. Ballance, Donald J. Wolford, Jerzy Bernholc, and Eugene E. Haller 21 Nov. 1990 1082 p Proceedings of the Materials Research Society Symposium, Boston, MA, 27 Nov. - 1 Dec. 1989
(Grant AF-AFOSR-0081-90)
(AD-A229590; AFOSR-90-1059TR) Avail: NTIS HC/MF A99 CSCL 09/1

This volume of proceedings contains manuscripts from Symposium G, entitled Impurities, Defects, and Diffusion in Semiconductors: Bulk and Layered Structures. This symposium was conceived from the view that impurities, defects, and diffusion play key roles in modern-day research and development of semiconducting materials, structures, and devices. Recent breakthroughs in materials preparation with monolayer control, in diversity and sensitivity of characterization techniques, and in new theoretical methods, have collectively led to great advances in the understanding of defect- and impurity-related phenomena. GRA

N91-30953# Sandia National Labs., Albuquerque, NM.
COMPARISON OF LOW-ENERGY X RAY AND COBALT-60 IRRADIATIONS OF MOS DEVICES AS A FUNCTION OF GATE BIAS
M. R. Shaneyfelt, D. M. Fleetwood, J. R. Schwank, and K. L. Hughes (L and M Technologies, Inc., Albuquerque, NM.) 1991 5 p Presented at the IEEE Annual International Nuclear and Space Radiation Effects Conference, San Diego, 15-19 Jul. 1991
(Contract DE-AC04-76DP-00789)
(DE91-008174; SAND-91-0448C; CONF-910751-4) Avail: NTIS HC/MF A01

The E (exp - 1/2) electric field dependence of the saturated density of interface traps in metal oxide semiconductor (MOS) devices is used to improve estimates of charge yield during Co-60 irradiations. Previous discrepancies between 10-keV x-ray and Co-60 response are resolved. DOE

N91-30954*# Alabama Univ., Huntsville.
FNAS MATERIALS PROCESSING AND CHARACTERIZATION Final Technical Report, 12 Jan. - 17 Jul. 1991
John P. Golben 17 Jul. 1991 21 p
(Contract NAS8-36955)
(NASA-CR-188710; NAS 1.26:188710; TR-5-32560) Avail: NTIS HC/MF A03 CSCL 20L

Research on melt-sintered high temperature superconducting materials is presented. The vibrating sample magnetometer has become a useful characterization tool for the study of high temperature superconductors. Important information regarding the superconducting properties of a sample can be obtained without actually making contact with the sample itself. A step toward microgravity processing of high temperature superconductors was taken. In the future, the samples need to be optimized prior to this processing of the sample before the specific effects of the microgravity environment can be isolated. A series of melt-sintered samples show that bulk processing of high temperature superconductors is getting better. Author

N91-30955# Arizona State Univ., Tempe.
SPATIAL LIGHT MODULATORS WITH ARBITRARY QUANTUM WELL PROFILES Annual Technical Report, 14 Jan. 1990 - 14 Jan. 1991
George N. Maracas and Krishan K. Bajaj (Emory Univ., Atlanta, GA.) 14 Jan. 1991 21 p
(Grant AF-AFOSR-0118-90; AF Proj. 3484)
(AD-A238149; AFOSR-91-0570TR) Avail: NTIS HC/MF A03 CSCL 20/12

The program has successfully grown GaAs/A/GaAs triangular and parabolic compositionally graded wells by solid source (SS) Molecular Beam Epitaxy (MBE) and gas source (GS) molecular beam epitaxy (GSMBE). In addition, strained in GaAs/GaAs wells have also been grown. An optimization of growth conditions for obtaining narrow exciton linewidths in square and nonrectangular wells was completed. We have refined the superlattice compositional grading technique to obtain 3 meV photoluminescence linewidths in a triangular quantum well. A study of the optical properties has begun in which the structures are characterized by room temperature and 2 K photoluminescence and photocurrent spectroscopies. Responsivity curves for structures having various well shapes have shown the excited states and a comparison with theory is in progress. A preliminary comparison of contrast ratios in rectangular and triangular SEED devices has been completed. Calculations of exciton transition energies, oscillator strength and modulator absorption ratios have successfully been performed for quantum wells having different profiles. The behavior of these structures as a function of electric field has also been performed. It was shown theoretically that asymmetric triangular quantum wells exhibit large contrast ratios at low electric fields. GRA

N91-30956# Texas Univ., Austin. Dept. of Electrical and Computer Engineering.
QUANTITATIVE RHEED STUDIES OF MBE GROWTH OF III-V COMPOUNDS Final Report, 1 May 1988 - 30 Apr. 1991
Ben G. Streetman 3 Jun. 1991 9 p
(Contract DAAL03-88-K-0060)
(AD-A238350; ARO-24858.23-EL) Avail: NTIS HC/MF A02 CSCL 14/2

The objectives were to develop methods for extracting quantitative information from the Reflection High Energy Electron Diffraction (RHEED) pattern about the surface structure of nearly perfect crystals prepared by Molecular Beam Epitaxy (MBE) and to use these techniques to explore in detail the growth of homo- and hetero-epitaxial structures involving GaAs, AlAs, InAs, and related ternary compounds. The overall problem addressed is the development of highly controlled growth of multilayers, quantum wells, delta doping, Bragg reflectors, and other structures which can then be exploited in advanced electronic and photonic devices. GRA

N91-30957# California Univ., Los Angeles. Dept. of Electrical Engineering.
QUANTUM DEVICES AND STRUCTURES USING Si-BASED MOLECULAR BEAM EPITAXY Final Technical Report, 15 Jun. 1986 - 14 Dec. 1989
K. L. Wang 15 May 1991 107 p
(Contract DAAL03-86-K-0104)
(AD-A238374; ARO-23646.33-EL) Avail: NTIS HC/MF A06 CSCL 20/12

Research findings are summarized in five scientific areas: (1) study of strain in SiGe layers by reflection high energy electron diffraction (RHEED); (2) Silicide/Si quantum well structures; (3) development of theory and design for superlattice device; (4)

miniband conduction in SiGe/Si superlattices; and (5) intersubband infrared absorption between valence minibands of symmetrically strained SiGe/Si superlattices. GRA

N91-30958# EPIR Ltd., Oakbrook, IL.
EVALUATION OF THE FEASIBILITY AND THE COST OF HgCdTe EPITAXIAL LAYERS GROWN BY MOLECULAR BEAM EPITAXY ON CdTe, CdZnTe, AND GaAs SUBSTRATES Final Report, 15 Jul. 1990 - 14 Jan. 1991
Jean-Pierre Faurie 14 Jan. 1991 19 p
(Contract F49620-90-C-0062)
(AD-A238602; AFOSR-91-0578TR) Avail: NTIS HC/MF A03 CSCL 11/6

In this contract which has been awarded to EPIR Ltd., two tasks were assigned. The first one was related to the evaluation of the cost Mercury Cadmium Tellurium epitaxial layers grown by Molecular Beam Epitaxy (MBE) on various substrates. The substrates which were supposed to be considered are Cadmium Telluride, CdZnTe and Gallium Arsenic. In addition, EPIR has also analyzed the cost on silicon substrates since Si is currently considered to be the most important substrates for IR photodiode technology. The second task was related to the feasibility of growing a few HgCdTe epilayers by MBE with at least one exhibiting standard specifications. GRA

N91-30959# Midwest Research Inst., Golden, CO.
STRUCTURE OF AMORPHOUS SILICON AND GERMANIUM ALLOY FILMS
R. E. Norberg and P. A. Fedders (Washington Univ., Saint Louis, MO.) Jul. 1991 31 p
(Contract DE-AC02-83CH-10093)
(DE91-002191; SERI/TP-214-4394) Avail: NTIS HC/MF A03

The primary objective of the research is to improve the understanding at the microscopic level of amorphous silicon and germanium film structures deposited under various methods. The work is to correlate and theoretically analyze, nuclear magnetic resonance, NMR, ESR, electron spin resonance, and other measurements. The alloys of concern include those obtained by adding dopants to hydrogenated silicon and germanium. The work has been directed to continue deuteron magnetic resonance DMR studies and to pay particulate attention to those structural features which may correlate with the photoelectronic properties of the material. The 1990 (DMR) accomplishments have included correlation of inhomogeneous nuclear spin relaxation with photovoltaic quality. In a second project, a structural rearrangement of atoms has been demonstrated to be associated with the light-induced metastability in a-Si:D, H films. A third approach has employed proton-deuteron coupled spin dynamics to examine hydrogen and deuterium motions in quality films of a-Si:H; a-Si:P,H; and a-Si:D,H. The B- P-doped films show a significantly enhanced hydrogen mobility above 200 K. We also have performed a number of detailed calculations on the effects coordination and strain on the deep electronic states rising from B and P dopants in a-Si as well as the band tail states in the gap of a-Si arising from strained bonds. This work gives a rather complete picture of the effects on the gap states of strain and dopants in the absence of H and for a given configuration of the a-Si network. We conclude that the methods that we have developed over the past three years are capable of describing many of the effects of strained bonds, especially their effect on dopants. DOE

N91-30960# Brookhaven National Lab., Upton, NY.
ELECTRON-YIELD EXAFS STUDIES OF Tb/FeCo AND Tb/Fe MULTILAYERS
Myung Hi Choi, Jung Hoon Joo, Jung Geun Lee, and Chang Sun Yang (SKC Ltd., Chonan, Republic of Korea) 1991 4 p Presented at the 3rd Synchrotron Radiation User's Workshop, Pohany, Republic of Korea, 13-14 Apr. 1991
(Contract DE-AC02-76CH-00016)
(DE91-014786; BNL-46298; CONF-9104273-2) Avail: NTIS HC/MF A01

By using the electron-yield detection technique, the EXAFS spectra for Tb/FeCo and Tb/Fe multilayers, as well as a TbFeCo alloy and some reference thin films, have been measured. These multilayers were prepared by sputtering onto float-glass substrates, and had the total thickness of 1000 A with various individual layer thickness or period values. An electron detector was used for the measurements and the high quality of data shows that the electron-yield detection technique is especially suitable for studies of multilayers. Preliminary analysis results show some qualitative tendencies which need to be checked with more careful analyses and, if possible, with some low temperature data. DOE

N91-30961# Brookhaven National Lab., Upton, NY.
THE TIME EVOLUTION OF THE FIRST ORDER MAGNETIC PHASE TRANSITION IN Dy-4 PERCENT Y ALLOY
K. Tajima, J. Akimitsu, M. Akimitsu (Shibaura Inst. of Tech., Tokyo, Japan), L. Rebelsky, G. Gruebel, and G. Shirane 1991 9 p Presented at the International Conference on Magnetism, Edinburgh, Scotland, 1-7 Sep. 1991
(Contract DE-AC02-76CH-00016)
(DE91-015423; BNL-46346; CONF-910903-6) Avail: NTIS HC/MF A02

The first order magnetic transition of spiral to ferromagnetic structure of Dy-4 percent Y alloy has been investigated by means of synchrotron x-ray diffraction. The development of the ferromagnetic phase could be studied by x-ray diffraction measurement for the observation of the hexagonal to orthorhombic crystal distortion accompanying the first order magnetic transition. Below (Tc), the ferromagnetic and spiral phases coexist and the development of the ferromagnetic phase exhibits a time dependent behavior and is proportional to log(t) except in the early stage of the phase transition. DOE

N91-30962*# Old Dominion Univ., Norfolk, VA. Dept. of Mathematical Sciences.
MODELING Cr-TO-Tm AND Cr-TO-Tm-TO-Ho ENERGY TRANSFER IN YAG CRYSTALS Final Report, period ending 30 Nov. 1989
John J. Swetits 9 Sep. 1991 48 p
(Grant NAG1-957)
(NASA-CR-187764; NAS 1.26:187764) Avail: NTIS HC/MF A03 CSCL 20L

A systematic analysis of energy transfer processes in crystals of YAG doped with varying concentrations of Cr and Tm is described. Both spectral measurements and measurements of the temporal response to pulsed excitation are used to give independent determinations of the microscopic interaction parameter for Cr to Tm transfer. The different factors in influencing the temperature dependence of the Cr to Tm transfer are discussed. The dependence of the Tm cross-relaxation rate on Tm concentration is determined. Author

N91-30963# Technische Univ., Berlin (Germany, F.R.). Fachbereich Physik.
PARALLEL MEASUREMENT OF ENERGY FILTERED CONTRASTS IN CONVERGENT ELECTRON DIFFRACTION IMAGES Ph.D. Thesis [PARALLELE MESSUNG ENERGIEGEFILTERTER KONTRASTVERLAEUFE IN KONVERGENTEN ELEKTRONENBEUGUNGSBILDERN]
Eckhard Quandt 1990 116 p In GERMAN
(ETN-91-99442) Avail: NTIS HC/MF A06

Convergent electron diffraction images in crystal rocking process were recorded. Experimental contrast patterns of elastic and inelastic scattered electrons were obtained, which were in good agreement with theoretical results. A parallel detection system was built for the direct registration of electrons. A variable electron optical subsequent enlargement system composed of four quadrupoles was set up, and a linear photodiode array was used for the direct detection of spectra. The connection of the crystal rocking process with parallel detection allowed the recording of energy spectroscopic convergent electron diffraction images in free selectable, experimentally constant scattering vector. The process was verified on graphite. A second experiment series was carried out on MoSe2, in which elastic electrons and also electrons which

underwent the characteristic losses of molybdenum and selenium were recorded. ESA

N91-30964# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.).
PREPARATION OF CRYSTALLINE SiC THIN FILMS BY PECVD AND BY ION BEAM MODIFICATION OF SILICON
G. Derst, S. Kalbitzer (Max-Planck-Inst. fuer Kernphysik, Heidelberg, Germany, F.R.), G. Kroetz, and G. Mueller 1990 14 p Presented at MRS-Tagung, Strassburg, France, 27 Nov. 1990
(MBB-Z-0349-90-PUB; OTN-030985; ETN-91-99457) Avail: NTIS HC/MF A03

Thin crystalline (c) films of SiC are produced by Ion Beam Modification (IBM) of hetero epitaxial Si thin films On Sapphire (SOS) and by Plasma Enhanced Chemical Vapour Deposition (PECVD) onto c-Si and sapphire substrates. Both methods yield highly transparent c-material. The preparation procedures and the optical properties of these materials are described and applications to optical lithography are pointed out. ESA

N91-30965# Technische Univ., Eindhoven (Netherlands). Faculty of Electrical Engineering.
MOUNTING AND DC TO 18 GHz CHARACTERIZATION OF DOUBLE BARRIER RESONANT TUNNELING DEVICES
M. F. C. Schemmann, H. C. Heyker, J. J. M. Kwaspen, and T. G. vandeRoer Dec. 1989 137 p
(EUT-89-E-231; ISBN-90-6144-231-1; ISSN-0167-9708; ETN-91-99615) Avail: NTIS HC/MF A07

Double Barrier Resonant Tunneling (DBRT) devices manufactured by molecular beam epitaxy are investigated. Room temperature current versus voltage curves were measured for devices of 200, 100, 50, and 20 microns diameter and a triangular device with 380 sq micron area. Twenty micron devices were kept stable throughout the entire negative differential resistance (NDR) regions. No hysteresis was found in the I to V curves of devices measured in stable circuits. The temperature dependence of I to V curve of a 100 and a 200 micron device was measured in the range of -20 to 80 C. The impedence of the devices was measured at 10 MHz and in the range of 0.1 to 18 GHz. The measurements are corrected for the network in which the DBRT devices are embedded. A network model consisting of a conductance in parallel to a capacitance, a series (contact) resistance and an inductance is found to represent the small signal behavior of DBRT devices. The conductance at various biasing conditions compares well to the differential conductance found from DC measurements. The amount of device capacitance depends on the bias voltage and has a peak in the NDR region. ESA

N91-30966# Technische Univ., Eindhoven (Netherlands). Faculty of Electrical Engineering.
MICROWAVE NOISE MEASUREMENTS ON DOUBLE BARRIER RESONANT TUNNELING DIODES
J. J. M. Kwaspen, H. C. Heyker, J. I. M. Demarteau, and T. G. vandeRoer Dec. 1990 120 p
(EUT-90-E-242; ISBN-90-6144-242-7; ISSN-0167-9708; ETN-91-99622) Avail: NTIS HC/MF A06

Double Barrier Resonant Tunneling (DBRT) diodes have nonlinear current voltage characteristics with Negative Differential Resistance (NDR) regions. Biased in one of these NDR regions, the DBRT diode can be used for microwave amplification purposes, so knowledge of the diode's noise behavior is important from a physics point of view. Two noise parameter measurement methods were developed in which the DBRT diode is used in a reflection amplifier configuration with circulator to transform the active one port device into an active two port with separate input and output ports. The Noise Figure (NF) of the DBRT diode must be deembedded from the NF of the reflection amplifier. An equation for the NF of the DBRT diode is derived. Two different measurement methods are used. A (complicated) more exact method uses the measured S parameters of the actual circulator and accounts for reflections at the noise source, NF meter and DBRT diode. A mathematically simple method (three versions) uses only scalar data collected by the NF meter. The results from these two methods are compared and they coincide well. ESA

77 THERMODYNAMICS AND STATISTICAL PHYSICS

Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics.

For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

N91-30967# New Hampshire Univ., Durham. Dept. of Physics.
CHAOS IN CLASSICAL NONLINEAR FIELDS Final Technical Report, 1 Aug. 1988 - 31 Dec. 1989
Harvey K. Shepard and Dawn C. Meredith May 1990 14 p
(Grant AF-AFOSR-0253-88)
(AD-A229434; AFOSR-90-1122TR) Avail: NTIS HC/MF A03 CSCL 12/2

Chaotic behavior is studied in a high-dimensional periodic lattice version of the classical Hamiltonian phi-four field theory. Both single and double well potentials were considered. Examined is the existence of a global stochasticity threshold that varied with energy and initial conditions. The model was discretized using an algorithm due to Hirota that guarantees stability and energy conservation. Chaotic behavior was diagnosed using the Lyapunov exponent, with additional information from space-time profiles, Fourier power spectra, and phase space plots. Long time scales made it difficult to distinguish between asymptotically chaotic and integrable behavior. GRA

N91-30968# David Taylor Research Center, Bethesda, MD.
CHAOS DISPLAYED BY SOLUTIONS OF A FORCED PENDULUM EQUATION WITH A FIFTH-ORDER POLYNOMIAL FOR THE DAMPING TERMS Final Report
Hans J. Lugt and Michael L. Brabanski Nov. 1990 35 p
(AD-A229496; DTRC-90/031) Avail: NTIS HC/MF A03 CSCL 20/4

Solutions of a forced pendulum equation of one degree-of-freedom with nonlinear damping terms have been studied for chaotic and dissipative behavior. This equation can simulate phenomena in which vortex shedding from oscillating and rotating bodies is involved. The characteristic properties of this equation, that is, its singular points, attractors, separatrices, etc. are investigated and related to their physical meaning. A novel attractor is found that represents simultaneously autorotation and self-sustained oscillation. Chaotic behavior is studied with Poincare maps and power spectra. Strange attractors exist which are insensitive to various pendulum coefficients. Of Navy interest are pendulum-type equations that model the rolling motion of ships. This motion can exhibit chaotic behavior. Another example of Navy interest is the usefulness of an extended pendulum equation to describe rotating and oscillating objects in a fluid, a problem whose solution otherwise would require the numerical integration of a set of nonlinear partial differential equations. This case will be studied in this report in more detail. GRA

N91-30969# National Inst. of Standards and Technology, Gaithersburg, MD.
JOURNAL OF RESEARCH OF THE NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY, MARCH - APRIL 1991, VOLUME 96, NUMBER 2
1991 109 p
(PB91-187617; LC-89-656121) Avail: NTIS HC/MF A06; also available SOD HC $3.75 as 703-027-00039-3 CSCL 05B

The following subject areas are covered: linearity of a silicon photodiode at 30 MHz and its effect on heterodyne measurements; use of the electrostatic classification method to size 0.1 micrometer SRM particles - a feasibility study; a multiple variable-angle light scattering detector for gel permeation chromatography; proposed new electrolytic conductivity primary standards for KCl solutions; digital image analysis assisted microradiography - measurement

of mineral content of caries lesions in teeth; bidirectional scattering distribution function - a systematized bibliography; and a limited international intercomparison of responsivity scales at fiber optic wavelength. Author

N91-30970*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
TPS DESIGN FOR AEROBRAKING AT EARTH AND MARS
S. D. Williams, M. M. Gietzel, W. C. Rochelle (Lockheed Engineering and Sciences Co., Houston, TX.), and D. M. Curry Aug. 1991 62 p
(NASA-TM-104739; S-645; NAS 1.15:104739) Avail: NTIS HC/MF A04 CSCL 22B

An investigation was made to determine the feasibility of using an aerobrake system for manned and unmanned missions to Mars, and to Earth from Mars and lunar orbits. A preliminary thermal protection system (TPS) was examined for five unmanned small nose radius, straight bi-conic vehicles and a scaled up Aeroassist Flight Experiment (AFE) vehicle aerocapturing at Mars. Analyses were also conducted for the scaled up AFE and an unmanned Sample Return Cannister (SRC) returning from Mars and aerocapturing into Earth orbit. Also analyzed were three different classes of lunar transfer vehicles (LTV's): an expendable scaled up modified Apollo Command Module (CM), a raked cone (modified AFT), and three large nose radius domed cylinders. The LTV's would be used to transport personnel and supplies between Earth and the moon in order to establish a manned base on the lunar surface. The TPS for all vehicles analyzed is shown to have an advantage over an all-propulsive velocity reduction for orbit insertion. Results indicate that TPS weight penalties of less than 28 percent can be achieved using current material technology, and slightly less than the most favorable LTV using advanced material technology. Author

80 SOCIAL SCIENCES (GENERAL)

Includes educational matters.

N91-30971# Wichita State Univ., KS. National Inst. for Aviation Research.
WOMEN IN THE AEROSPACE ENGINEERING FACULTY OF HIGHER EDUCATION
Brent Bowen and Julie Mathis 1991 24 p
(NIAR-91-22) Avail: NTIS HC/MF A03

Americans society has made some progress in accepting women and minorities in the work place. Successes are visible in many careers. Achievement is evident in all; however, encouragement for women and minorities to participate in engineering has not paralleled these successes with fully demonstrated achievement. This study analyzes U.S. Department of Education and other available statistics on women and minorities in higher education. This data is then compared to data collected on aerospace engineering faculty through a structured interview process applied to all U.S. colleges and universities offering a baccalaureate degree and above in aerospace engineering. A comparison is then made to establish whether or not women and minorities are under represented in the collegiate aerospace engineering faculty is representative of the participation of women and minority faculty in higher education overall. This data will also be compared to data on the number of women and minorities receiving engineering degrees, with attention to those receiving doctoral degrees. This research effort will offer a demographic analysis of engineering education as it proceeds to apply the general findings specifically to the field of aerospace engineering. Recommendations on how to encourage increased numbers of women and minorities to become engineering educators as well as analyze why better representation has not yet been achieved. Author

81 ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

N91-30972# Army Construction Engineering Research Lab., Champaign, IL.
HQ-IFS MAINTENANCE RESOURCE PREDICTION MODEL (MRPM) USER'S MANUAL Final Report
Boon Goh, Edgar S. Neely, and Robert Neathammer Oct. 1990 246 p
(AD-A229297) Avail: NTIS HC/MF A11 CSCL 15/5

Maintenance Resource Prediction Models (MRPMs) are a set of models that run on various computer systems to assist Army managers in planning and programming maintenance resources, based on the anticipated resource requirements of actual installation facilities, for prediction periods of 1 to 10 years. There are three types of MRPM systems: (1) Headquarters-Integrated Facilities (HQ-IFS); (2) Major Command (MACOM); and (3) Installation Research systems. This user's manual covers the HQ-IFS MRPM system, and describes system operations at the Army, MACOM, and Reporting Installation levels. Separate sections explains the application of the HQ-IFS MRPM to each level, through step-by-step description and screen illustration of each program function. The HQ-IFS mainframe host computer can be accessed by a DOS-based, personal computer system through the use of terminal emulation software. Maintenance Resource Prediction Models (MRPMs) are a set of models that run on various computer systems to assist Army managers to plan and program maintenance resources, based on the anticipated resource requirements of actual installation facilities, for prediction periods of 1 to 10 years. GRA

N91-30973# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Systems and Logistics.
THE IDENTIFICATION OF CONTRACTING TERMS IN SUPPORT OF THE BODY OF KNOWLEDGE M.S. Thesis
William J. Hauf Sep. 1990 79 p
(AD-A229419; AFIT/GCM/LSP/90S-4) Avail: NTIS HC/MF A05 CSCL 05/2

This theses studied the advancement of professionalism within the contracting work force and established a baseline of contracting terms that, when defined, will form a dictionary of contracting terminology. This theses is a part of an effort at both the Air Force Institute of Technology and Naval Postgraduate School to identify and define those terms to be included in the initial publication of a dictionary by the National Contract Management Association. This study had two main objectives: first, to examine how further developing the contracting body of knowledge will enhance the professionalism of the contracting discipline and work force; and second, to compile a master listing of candidate terms to be defined by associated research leading to the eventual publication of a dictionary. A master listing of terms, built using the comments and recommendations of selected experts in the contracting and education fields is the main product of this research effort. GRA

N91-30974# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Systems and Logistics.
DEFINING ACQUISITION AND CONTRACTING TERMS ASSOCIATED WITH CONTRACT ADMINISTRATION M.S. Thesis
Laureli M. Moyle Sep. 1990 147 p
(AD-A229462; AFIT/GCM/LSY/90S-10) Avail: NTIS HC/MF A07 CSCL 05/1

The purpose of this study was to synthesize definitions for 20 terms associated with contract administration. To accomplish this objective, research on dictionary and definition development was conducted. Also, literature was comparatively analyzed to synthesize definitions for each term. To validate the definitions a survey was administered to the NCMA Fellows. Respondents evaluated each definition using a Likert scale and provided written comments. Likert scale results were presented in bar chart form

along with an arithmetic mean. Plus, if warranted, the respondents' suggestions were incorporated into the final definitions. As a result, finalized proposed definitions were developed and recommended for inclusion in any future dictionary of contract terminology. In conclusion, the need for further research will continue until all unique and arbitrary words in the contract management arena have been thoroughly researched and their descriptions documented. GRA

N91-30975# Air Force Inst. of Tech., Wright-Patterson AFB, OH.
THE EFFECT OF THE COMMERCIAL SPACE LAUNCH ACT ON DEPARTMENT OF DEFENSE CONTRACT ADMINISTRATION M.S. Thesis
Michael E. Hale Sep. 1990 114 p
(AD-A229497; AFIT/GCM/LSP/90S-3) Avail: NTIS HC/MF A06 CSCL 05/1

This study analyzes the Commercial Space Launch Act and the effect of the Act on Department of Defense contract administration. The Act is commercial space launch industry. The literature review provides a comprehensive overview of the Act, the current environment of space commercialization, and the future of the space launch industry. The method of acquiring the necessary data used in the study was the telephone interview. Commanders of Department of Defense contract administration units were surveyed to determine their knowledge and awareness of the Act. The study found that the Act was being administered adequately at those locations which reported involvement; however, there were serious problems in the administrative guidance on the Act and the process of reimbursement for government provided contract administrative services. The study makes numerous recommendations for improvement to include: rewriting the current Act guidance and forming a focal point for commercial space within the newly formed Defense Contract Management Command. GRA

N91-30976# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Systems and Logistics.
DICTIONARY OF CONTRACTING AND ACQUISITION TERMS RELATED TO THE PRE-AWARD PHASE OF CONTRACTING M.S. Thesis
Randal G. Indvik Sep. 1990 172 p
(AD-A229533; AFIT/GCM/LSP/90S-7) Avail: NTIS HC/MF A08 CSCL 05/1

This theses effort is a continuance of research to determine, through a consensus of opinion among contracting professionals, a definition for current contracting terminology. This research was first initiated by LCDR Daniel L. Ryan, and was later accomplished by others at both the Naval Postgraduate School, Monterey, California, and at the Air Force Institute of Technology, Wright Patterson Air Force Base, Ohio. As with the previous efforts, this theses examined literary sources for the current definitions and usages of the chosen terms. Thereafter a definition for each term was synthesized, incorporated in an open ended survey, and sent to contracting professionals (NCMA Fellows). Respondent comments are analyzed, and, where appropriate, incorporated in the final, proposed definitions. Researchers efforts to define additional terms should be continued in accordance with the recommendations presented in chapter 5. GRA

N91-30977# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Systems and Logistics.
A LEXICON OF CONTRACTING TERMS: CONTRACT TYPES M.S. Thesis
Dean R. Matro Sep. 1990 125 p
(AD-A229534; AFIT/GCM/LSP/90S-9) Avail: NTIS HC/MF A06 CSCL 05/1

This thesis continued the National Contracting Management Association (NCMA) sponsored research effort of creating a dictionary of acquisition and contracting terms. Research is currently being conducted at the Air Force Institute of Technology, Wright-Patterson AFB, Ohio, and the Naval Postgraduate School, Monterey, California. This effort focused on defining government contract types. Limited to the compensation arrangement and contract form type contracts, a literature review identified 26 contract types. Attributes for each contract type were tabulated, which led to synthesized definition. A written survey was distributed to a sample group of contracting professionals, requesting their feedback. Predetermined decision rules were applied in conjunction with the literature review and the survey to minimize the personal subjectivity of the research. Moderate consensus on the definitions was achieved after evaluating 42 surveys. GRA

N91-30978# Office of Technology Assessment, Washington, DC.
REDESIGNING DEFENSE: PLANNING THE TRANSITION TO THE FUTURE US DEFENSE INDUSTRIAL BASE
Jul. 1991 125 p
(OTA-ISC-500) Avail: NTIS HC/MF A06; also available SOD HC $5.50 as 052-003-01249-9

The objecives of the Defense Technology and Industrial Base (DTIB) are discussed. This report examines emerging U.S. national security requirements, surveys the current conditions and trends in the DTIB, and proposes some desirable characteristics for the future base. The report concludes with a discussion of the broad strategic choices and tactical decisions that must be considered as the Nation moves to this future base. The findings of the report will provide a framework for the debate over the size and character of the future DTIB and will assist Congress in selecting criteria for making the difficult policy and budget choices that will be required to facilitate the transition. M.G.

N91-30979# Government-Univ.-Industry Research Roundtable, Washington, DC.
SUMMARY OF INTERIM REPORTS SUBMITTED BY GRANTEE ORGANIZATIONS PARTICIPATING IN THE FEDERAL DEMONSTRATION PROJECT
A. Scanley and W. Sellers 1 Oct. 1990 22 p
(Contract DE-FG05-89ER-75498)
(DE91-013938; DOE/ER-75498/7) Avail: NTIS HC/MF A03

The Federal Demonstration Project (FDP) is a cooperative effort among 28 academic institutions, a private research institute, and 11 federal agencies to increase research productivity by eliminating unnecessary administrative procedures and by streamlining and standardizing needed controls. The Government-University-Industry Research Roundtable serves as a logistical center, a neutral convener for discussion of issues affecting the FDP, and as a catalyst for the implementation of procedures successfully demonstrated the FDP. The FDP is an outgrowth of the earlier Florida Demonstration Project. The most successful of the procedures demonstrated in Florida (carry-forward, rebudgeting, pre-award costs, and no-cost extension) have been approved for use nationwide by all research sponsoring federal agencies. These " expanded authorities" are also the core of the terms and conditions that apply to grants issued under the current FDP. As new demonstrations are developed under the FDP, they are added to the core terms and conditions. Four-demonstrations have been implemented under the Federal Demonstration Project: Non-Competing Renewals in July 1989; Equipment Screening in April 1990; Documentation and Allocation Standard in July 1990; and Rights-in-Data in July 1990. A fifth demonstration, dealing with representations and certifications, was announced in July 1989 but withdrawn that September. Others are in the development stage. As required by the letter of agreement that formalizes participation in the FDP, each of the participating grantee organizations has submitted in interim report that describes the steps taken to implement the FDP and the impact of the FDP on the organization. DOE

N91-30980# Government-Univ.-Industry Research Roundtable, Washington, DC.
INDUSTRIAL PERSPECTIVES ON INNOVATION AND INTERACTIONS WITH UNIVERSITIES: SUMMARY OF INTERVIEWS WITH SENIOR INDUSTRIAL OFFICIALS
Feb. 1991 29 p Prepared in cooperation with Industrial Research

Inst., Inc., New York, NY
(Contract DE-FG05-89ER-75498)
(DE91-013939; DOE/ER-75498/9) Avail: NTIS HC/MF A03

As a natural extension of earlier Government-University-Industry Research Roundtable efforts that mapped the diversity of university-industry research alliances, the Roundtable, in conjunction with the Industrial Research Institute, has examined industrial perspectives on how innovation occurs and on how alliances with universities are expected to contribute to technical change and competitiveness within individual companies. This examination was carried out initially through individual discussions with seventeen senior research managers representing a range of fields of research as well as a variety of sizes and types of companies. The results of the individual interviews were summarized and reviewed by the industry interviewees, a few members of the Roundtable Council, and senior federal R and D officials at a meeting in October 1990. Comments from that meeting have been incorporated into the summary of the interviews presented here. DOE

N91-30981# Government-Univ.-Industry Research Roundtable, Washington, DC.
RESEARCH FACILITY FINANCING: NEAR-TERM OPTIONS
Feb. 1991 21 p
(Contract DE-FG05-89ER-75498)
(DE91-013940; DOE/ER-75498/8) Avail: NTIS HC/MF A03

To address the financing of research facilities at universities, colleges, and independent nonprofit research institutions, this paper outlines options for policy changes on which agreement and initial action may be possible in the near future. As used in this discussion, the term research facilities refers to the buildings, building systems (such as power and ventilation), and fixed equipment (for example, benches and hoods) that constitute the physical plant for research. The Research Roundtable is concerned with the vitality of the nation's science and engineering research enterprise. It was established to deepen the understanding of issues that divide the partners in the research enterprise and to provide a setting for seeking common ground. By setting forth the overview of options contained herein, the Roundtable aims to facilitate the development, by the stake holders in the research enterprise, of specific proposals for new research facility financing policies. To the extent that consensus on appropriate changes emerges from dialogue furthered by this paper, a basis for action will have been laid. DOE

N91-30982*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
CORRELATIVE VISUALIZATION TECHNIQUES FOR MULTIDIMENSIONAL DATA
Lloyd A. Treinish and Craig Goettsche Oct. 1989 49 p
(NASA-TM-105073; NAS 1.15:105073;
NSSDC/WDC-A-R/S-89-26) Avail: NTIS HC/MF A03 CSCL 05A

Critical to the understanding of data is the ability to provide pictorial or visual representation of those data, particularly in support of correlative data analysis. Despite the advancement of visualization techniques for scientific data over the last several years, there are still significant problems in bringing today's hardware and software technology into the hands of the typical scientist. For example, there are other computer science domains outside of computer graphics that are required to make visualization effective such as data management. Well-defined, flexible mechanisms for data access and management must be combined with rendering algorithms, data transformation, etc. to form a generic visualization pipeline. A generalized approach to data visualization is critical for the correlative analysis of distinct, complex, multidimensional data sets in the space and Earth sciences. Different classes of data representation techniques must be used within such a framework, which can range from simple, static two- and three-dimensional line plots to animation, surface rendering, and volumetric imaging. Static examples of actual data analyses will illustrate the importance of an effective pipeline in data visualization system. Author

N91-30983*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
SPACE PHYSICS ANALYSIS NETWORK NODE DIRECTORY (THE YELLOW PAGES): FOURTH EDITION
David J. Peters, Patricia L. Sisson, James L. Green, and Valerie L. Thomas Aug. 1989 102 p
(NASA-TM-105068; NSSDC/WDC-A-R/S-89-14; NAS 1.15:105068) Avail: NTIS HC/MF A06 CSCL 05A

The Space Physics Analysis Network (SPAN) is a component of the global DECnet Internet, which has over 17,000 host computers. The growth of SPAN from its implementation in 1981 to its present size of well over 2,500 registered SPAN host computers, has created a need for users to acquire timely information about the network through a central source. The SPAN Network Information Center (SPAN-NIC) an online facility managed by the National Space Science Data Center (NSSDC) was developed to meet this need for SPAN-wide information. The remote node descriptive information in this document is not currently contained in the SPAN-NIC database, but will be incorporated in the near future. Access to this information is also available to non-DECnet users over a variety of networks such as Telenet, the NASA Packet Switched System (NPSS), and the TCP/IP Internet. This publication serves as the Yellow Pages for SPAN node information. The document also provides key information concerning other computer networks connected to SPAN, nodes associated with each SPAN routing center, science discipline nodes, contacts for primary SPAN nodes, and SPAN reference information. A section on DECnet Internetworking discusses SPAN connections with other wide-area DECnet networks (many with thousands of nodes each). Another section lists node names and their disciplines, countries, and institutions in the SPAN Network Information Center Online Data Base System. All remote sites connected to US-SPAN and European-SPAN (E-SPAN) are indexed. Also provided is information on the SPAN tail circuits, i.e., those remote nodes connected directly to a SPAN routing center, which is the local point of contact for resolving SPAN-related problems. Reference material is included for those who wish to know more about SPAN. Because of the rapid growth of SPAN, the SPAN Yellow Pages is reissued periodically. J.P.S.

N91-30984# Naval Sea Systems Command, Washington, DC.
PROCEEDINGS OF THE 28TH ANNUAL TECHNICAL SYMPOSIUM ON ACHIEVING TECHNICAL AND MANAGEMENT EXCELLENCE
J. Johnston, D. OColman, and C. Mathai 1991 257 p Symposium held in Arlington, VA, 11 Apr. 1991
(PB91-189134) Avail: NTIS HC/MF A12 CSCL 05A

The following topics are covered: (1) an affordability focus on the Shipbuilding and Conversion, Navy (SCN) funds; (2) systems engineering in ship design; (3) combat systems engineering process; (4) the effects of confined water operation on ship performance; (5) video enhanced Ship Energy Conservation Assist Team (SECAT) Program; (6) quality ship service power with an integrated diesel electric propulsion plant; (7) electromagnetic interference; (8) damage control as the last line of defense and guardian of sustained mission capability; (9) probabilistic ship structural design; (10) naval shipyard corporate operations strategy and plan; (11) improving the naval ship design, acquisition, and construction process; (12) sea systems modification and modernization by modularity (SEAMOD); (13) hazardous material and hazardous waste management within the Navy; (14) computer-aided acquisition and logistics management system; (15) why engineers don't understand logistics; (16) operational use of low level white lighting; and (17) the FFG61 prototype digital technical library. GRA

N91-30985# Grenoble-1 Univ. (France). Lab. Artemis.
REASONING ABOUT CONSTRAINTS: SCHEDULING APPLICATION Ph.D. Thesis [RAISONNEMENT SUR LES CONTRAINTES: APPLICATION EN ORDONNANCEMENT]
Danielle Ziebelin 1990 233 p In FRENCH; ENGLISH summary
(ETN-91-99488) Avail: NTIS HC/MF A11

A method using problem solving knowledge on easier problems was adopted to find solutions to workshop scheduling problems. The development of a schedule to cope with the preferences which were expressed is very complicated when the set of constraints is too large and conflictual to be solved directly. A strategy which evaluates the interaction between constraints and groups that lead to the same schedule of simplified subproblems is proposed. A solution to these subproblems takes the form of a series of tasks satisfying the constraints. In combination with other solutions, this solution can guide the scheduling system in its choices for constraint satisfaction. Close cooperation is required between constraint analysis decisions and scheduling decisions. The system must be able to adapt its problem solving strategy in terms of evolution of the solution. A blackboard base architecture was chosen, with regard to the cooperative and opportunistic nature of the system. ESA

N91-30986# National Aerospace Lab., Amsterdam (Netherlands). Informatics Div.

METHOD BASE SYSTEM AND EXECUTIVE, TOOLS FOR MANAGEMENT AND EXECUTION OF SOFTWARE SYSTEMS FOR CAE

J. J. Schuurman and W. Loeve 28 Apr. 1989 17 p Presented at 2nd International Conference on Computer Applications in Production and Engineering, Tokyo, Japan, 2-5 Oct. 1989

(NLR-TP-89169-U; ETN-91-99551) Avail: NTIS HC/MF A03

The design and development of information systems for digital simulation in Computer Aided Engineering (CAE) is a continuous activity, following the development of mathematical models, numerical techniques and computers. The resulting incremental development of software systems passes stringent requirements on the management of software configurations. In addition to the traditional management of source code in program libraries, it has been proved to be necessary to manage software components in terms of their function, their implementation, and their relation to other software components. In this way, software components can be used consistently in different configurations. The development of a Method Base System (MEBAS), for version management and reuse of software, which is designed to support the above mentioned type of management of software components in MEBAS is implemented as an empty shell in which source code is stored together with descriptions of its function and implementation. In order to support execution of (combinations of) software components on a network of computers an executive is developed. ESA

N91-30987# General Accounting Office, Washington, DC. National Security and International Affairs Div.

SPACE PROJECT TESTING: UNIFORM POLICIES AND ADDED CONTROLS WOULD STRENGTHEN TESTING ACTIVITIES

Sep. 1991 42 p

(GAO/NSIAD-91-248; B-245141) Avail: NTIS HC/MF A03

The General Accounting Office (GAO) reviewed the National Aeronautics and Space Administration's (NASA) testing activities to assess the adequacy of NASA's testing policies and practices, NASA's oversight of contractor testing, and the adequacy of resources available for testing. Because space missions are inherently risky, systems cannot be easily repaired while in orbit, and failures are widely publicized, it is especially important that system performance be thoroughly tested before launch. These complex systems are usually acquired in very limited quantities, and test programs are specifically tailored for each project. In this report, GAO recommends that the NASA Administrator: (1) define and issue testing policies regarding testing goals, minimum requirements, and organizational roles and responsibilities for ensuring that tests are properly planned, conducted, and reported; (2) establish agencywide test standards; and (3) make specific improvements in contractor testing oversight such as increasing the level of civil servants' knowledge and skills to enable them to better critique technical contractor designs, tests, and operations. J.P.S.

N91-30988# General Accounting Office, Washington, DC. Information Management and Technology Div.

SPACE COMMUNICATIONS: BETTER UNDERSTANDING OF SCHEDULING SYSTEM LIMITATIONS NEEDED

Sep. 1991 35 p

(GAO/IMTEC-91-48; B-243986) Avail: NTIS HC/MF A03

The General Accounting Office (GAO) reviewed the National Aeronautics and Space Administration (NASA) system for scheduling usage of the Tracking and Data Relay Satellite System (TDRSS) in regards to efficiency and effectiveness. GAO and NASA agree that additional automation, some already developed, would aid the scheduling system; however, testing and implementation of further automation would require scarce resources, already assigned to another project. GAO recommends that NASA collect additional data and re-evaluate its resource allocations. NASA maintains that their study was adequate, and that postponement of improvements to the TDRSS scheduling system is an acceptable tradeoff. J.P.S.

82 DOCUMENTATION AND INFORMATION SCIENCE

Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography.

For computer documentation see *61 Computer Programming and Software.*

N91-30989# Air Force Inst. of Tech., Wright-Patterson AFB, OH.

A MANAGEMENT INFORMATION SYSTEM FOR THE ENERGY CONSERVATION PROGRAM M.S. Thesis

Benjamin H. Cutler Sep. 1990 63 p

(AD-A229574; AFIT/GEM/LSM/90S-5) Avail: NTIS HC/MF A04 CSCL 05/1

This study investigated the possibility of creating an energy accounting system based on currently identified objectives. The initial focus was to determine if such a system would be useful. Conditions which led to the energy crises in the 1970's still exist and indicators show that the United States is more dependent upon foreign oil than at any time in the past. There was also a failure to meet the 1985 energy reduction goal of 20 percent. Adding to the problem is escalating pressure to trim the Federal budget. The greatest pressure is on the Department of Defense, so there is a need to improve the methods used to determine how to decrease facility energy consumption. It was found that new systems need to decrease the time required to prepare reports, allow for customized reports, and provide a method for upward reporting to contract data. The result of this study showed that it was possible to create such a system, but given the tools currently available not all of the objectives were obtainable. GRA

N91-30990# Institute for Naval Oceanography, Bay Saint Louis, MS.

PROGRESS ON DATA ACCESSION AND PREPARATION OF USER'S GUIDES Special Project Report

C. A. Lai Jul. 1990 50 p

(AD-A234920; INO-SP-3) Avail: NTIS HC/MF A03 CSCL 05/2

Institute for Naval Oceanography (INO) progress on data accession for use in model experiments and evaluation under the Experimental Center for Mesoscale Ocean Prediction (ECMOP) Project is described. Also discussed is the status of the preparation of user's guides for climatology, hurricane MOODS, and GEOSAT data, as well as design of an INO data library. GRA

N91-30991*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

DIRECTORY INTERCHANGE FORMAT MANUAL, VERSION 3.0

Dec. 1990 94 p

(NASA-TM-105034; NSSDC/WDC-A-R/S-90-27; NAS 1.15:105034) Avail: NTIS HC/MF A05 CSCL 05B

The Directory Interchange Format (DIF) is a data structure

used to exchange directory level information about data sets among information systems. The format consists of a number of fields that describe the attributes of a directory entry and text blocks that contain a descriptive summary of and references for the directory entry. All fields and the summary are preceded by labels identifying their contents. All values are ASCII character strings. The structure is intended to be flexible, allowing for future changes in the contents of directory entries. Author

N91-30992# Softech, Inc., Waltham, MA.
ACTIVITY AND INFORMATION MODELING METHODOLOGY ASSESSMENT Final Report, May - Nov. 1990
Clarence G. Feldman, Richard R. Preston, and Paul S. Thompson (Control Data Corp., Dayton, OH.) Apr. 1991 80 p
(Contract F33615-89-C-5708)
(AD-A236234; WL-TR-91-8012) Avail: NTIS HC/MF A05 CSCL 12/7

The objective of this program was to conduct a top-level assessment of activity (IDEF-O) and information (IDEF-1x) modeling methods needed to support overarching enterprise framework applications. The results provide a preliminary strategic plan, or blueprint, tailored to the needs related USAF and industry requirements for integrated information modeling capabilities. The plan is a systematic and incremental approach for strategic improvements relative to enterprise framework applications. GRA

N91-30993# Urban Inst., Washington, DC.
IMPROVEMENTS IN DATA ACQUISITION TECHNOLOGY FOR MAINTENANCE MANAGEMENT SYSTEMS Final Report
William A. Hyman, Ancel Dan Horn, Omar Jennings, Frederick Hejl, and Timothy Alexander (Space Development Services, Inc., Fort Washington, MD.) Dec. 1990 60 p Sponsored by Transportation Research Board; American Association of State Highway and Transportation Officials; and Federal Highway Administration
(NCHRP Proj. 14-10)
(PB91-164418; NCHRP-334; LC-90-71597; ISSN-0077-5614; ISBN-0-309-04857-5) Avail: NTIS HC/MF A04 CSCL 05B

Maintenance field managers are often burdened with laborious reporting requirements to support the maintenance management system. Advances in technology provide opportunities to better serve the needs of maintenance field managers and maintenance management generally. Most useful, accurate and timely information can be furnished the maintenance management system by using such technologies as laptops, hand held portable data entry terminals, bar coding, voice recognition, and location and navigation equipment, for example, distance measuring equipment and portable satellite Global Positioning System receivers. Facsimile machines, cellular phones, and satellite links can aid transmission of maintenance field data collection, assessment of alternative data acquisition technologies and procedures, and system designs for six areas of maintenance data collection: (1) daily reporting of accomplishment and labor, equipment and materials usage; (2) material and equipment inventory management and control; (3) roadway feature inventory updating; (4) inputs to short run scheduling; (5) bridge inspection and maintenance; and (6) monitoring of snow plow and blowing operations in remote and dangerous conditions. Author

N91-30994*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
PUBLICATIONS OF THE JET PROPULSION LABORATORY 1989
15 Dec. 1990 40 p
(NASA-CR-188690; JPL-Bibl-39-31; NAS 1.26:188690) Avail: NTIS HC/MF A03 CSCL 05B

This bibliography describes and indexes by primary author the externally distributed technical reporting, released during 1989, that resulted from scientific and engineering work performed, or managed, by JPL. Three classes of publications are included: JPL publications in which the information is complete for a specific accomplishment; articles from the quarterly Telecommunications and Data Acquisition (TDA) Progress Report; and articles published in the open literature. Author

N91-30995*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
NASA'S CLIMATE DATA SYSTEM PRIMER, VERSION 1.2
James W. Closs, Mary G. Reph, and Lola M. Olsen May 1989 107 p
(NASA-TM-105063; NSSDC/WDC-A-R/S-89-07; NAS 1.15:105063) Avail: NTIS HC/MF A06 CSCL 05B

This is a beginner's manual for NASA's Climate Data System (NCDS), an interactive scientific information management system that allows one to locate, access, manipulate, and display climate-research data. Additional information on the use of the system is available from the system itself. J.P.S.

N91-30996*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
THE NATIONAL SPACE SCIENCE DATA CENTER
Jan. 1989 45 p
(NASA-TM-105059; NAS 1.15:105059; NSSDC-88-26) Avail: NTIS HC/MF A03 CSCL 05B

An overview is presented of the services offered by the National Space Science Data Center (NSSDC). The NSSDC was established by the National Aeronautics and Space Administration (NASA) over 20 years ago to be the long-term archive for data from its space missions. NSSDC's goal is to provide the research community with data and attendant services in the most efficient, economical, and useful manner possible now and in the future. The organization is dedicated to getting the most scientific value out of NASA's initial investment in its missions. Each service available to scientists through the world is discussed. Also a contact person is identified for each service in case more information in needed. J.P.S.

N91-30997 California Univ., Los Angeles.
QUERY PROCESSING WITH DATABASE SEMANTICS Ph.D. Thesis
Rei-Chi Lee 1990 145 p
Avail: Univ. Microfilms Order No. DA9115451

Two issues of database query processing are addressed in this thesis: optimization and representation. Optimization is concerned with query processing techniques to quickly obtain answers from the database; and representation is concerned with query and answer representation between the users and the database systems. Conventional query processing takes a domain-independent approach to determine the optimal access plan for retrieving the answer. Semantic query optimization (SQO) uses knowledge and semantic reasoning to transform queries into more efficient representations for processing. Integrity constraints (IC) have been used as semantic knowledge for SQO. However, since the purpose of IC is to ensure database integrity, these constraints are often specified in a very general way. As a result, they are of limited value for SQO. Furthermore, acquiring the set of integrity constraints is also a problem. The first part of the thesis presents a model-based learning technique, based on a Knowledge-based Entity-Relationship (KER) model and rule induction techniques, that learns a set of if-then rules from the database contents. Experimental results show that not all the semantic knowledge is useful for query improvements. The second part of the thesis presents a database restructuring technique, based on type hierarchy and induced rules, which restructures databases to provide a more effective environment for SQO. Conventional query answers usually are in the form of listing all the instances that satisfy the query. An intensional answer provides characteristics that characterize the extensional answers which gives a summarized description about the answers. The final parts of the thesis present an approach that uses induced knowledge and type inference to derive intensional answers; and an approach of using type abstraction hierarchy to provide cooperative answers. Dissert. Abstr.

N91-30998# German National Research Center for Computer Science, Washington, DC.
PROMOTION OF INFORMATION TECHNOLOGY RESEARCH: GERMAN AND EUROPEAN STRATEGIES. PROCEEDINGS OF A FORUM AT THE EMBASSY OF THE FEDERAL REPUBLIC OF GERMANY
Wolfgang Toelle 1991 91 p Forum held in Washington, DC, 24 Jan. 1991
(PB91-188300) Avail: NTIS HC/MF A05 CSCL 05B

The following subject areas are covered: GMD's research program and commitment to international IT research cooperation and transfer; the promotion of information technology research by the German government; European R and D in information technology. Author

N91-30999# Federal Library and Information Center Committee, Washington, DC.
PROCEEDINGS OF THE FEDERAL PRE-WHITE HOUSE CONFERENCE ON LIBRARY AND INFORMATION SERVICES
Nov. 1990 122 p Conference held in Washington, DC, 26-27 Nov. 1990
(PB91-183558) Avail: NTIS HC/MF A06 CSCL 05B

In 1987, the Federal information community began its work toward full participation in the 2nd White House Conference on Library and Information Services (WHCLIS II). Federal librarians and information specialists organized a Federal Library and Information Center Committee (FLICC) Task Force for WHCLIS II. After reviewing the recommendations from WHCLIS I (1979), several main areas of continuing concern were identified: access, networking, preservation, and funding. These core national issues were addressed under the umbrella of: equal opportunity of access to Federal information. Another important outcome of the preconference was the identification of an agenda for FLICC's long range plans for Federal library and information development, including the determination of how Federal library and information center resources and services must be developed or expanded to meet agency and citizen needs. Author

N91-31000# National Technical Information Service, Springfield, VA.
A DIRECTORY OF SCIENTIFIC AND TECHNICAL INFORMATION PROGRAMS IN THE US GOVERNMENT
Apr. 1991 52 p
(PB91-180216) Avail: NTIS HC/MF A04 CSCL 05B

This directory provides a brief overview of the responsibilities of federal agencies in policy and programs for the dissemination of scientific and technical information (STI) in relation to federal research and development programs. Only those agencies with major legislative roles and responsibilities for STI policy and STI dissemination, and those agencies whose research and development budget was $50 million or more, are listed. The directory is intended both as a guide and as a means for comprehending the scope and relationships of these federal STI programs. In this listing STI includes information resulting from a government agency's mission, publications, numeric data, statistics, and graphics such as maps and charts in either printed or electronic media, It also includes information dissemination functions such as systematic collection, management, announcement, analysis, and dissemination of information on request, by subscription, and through information centers. J.P.S.

N91-31001 Politecnico di Milano (Italy). Lab. di Calcolatori.
EFFICIENT RETRIEVAL OF CLASS EXTENSIONS IN OBJECT-ORIENTED DATABASES
F. Cacace, P. Samarati (Milan Univ., Italy), and L. Tanca 1991 9 p
(Rept-91-019; ETN-91-99765) Avail: Politecnico di Milano, Piazzo Leonardo da Vinci 32, 20133 Milan, Italy

Many object oriented data models have been proposed in the past few years. The field is one of the most promising for the development of new generation database systems. With such complex data structures as those of object oriented systems, the problem of efficiently storing and retrieving (collection of) objects becomes of primary importance. Efficient set oriented algorithms for the storage and retrieval of objects in a complex inheritance hierarchy are presented. ESA

N91-31002 Politecnico di Milano (Italy). Lab. di Calcolatori..
CONCURRENCY IN DEDUCTIVE OBJECT-ORIENTED DATABASES
F. Cacace and L. Tanca 1991 20 p
(Rept-91-020; ETN-91-99766) Avail: Politecnico di Milano, Piazzo Leonardo da Vinci 32, 20133 Milan, Italy

A proposal for the integration of three distinct research areas: concurrent programming languages, deductive databases and object oriented databases is described. The proposal focuses on features of a database model in which data are structured using static concepts taken from the object oriented paradigm (i.e., classes, identity, inheritance, etc.), methods are implemented through rules in a declarative style, and a concurrent bottom-up semantics for the execution of programs is defined. ESA

N91-31003 Physics and Electronics Lab. TNO, The Hague (Netherlands).
DATA FUSION: A PRELIMINARY STUDY Final Report
A. P. Keene and M. Perre Dec. 1990 58 p
(FEL-90-B356; TD-90-4515; ETN-91-99817) Copyright Avail: Physics and Electronics Lab. TNO, P.O. Box 96864, 2509 JG The Hague, Netherlands

Military intelligence processing is an increasingly complex domain, due to the incorporation of data from multiple sensors. The information is distributed in space and time and is subject to uncertainty and incompleteness. The process of combining multi-sensor data into a model of the domain of interest is known as data fusion. Initial insight into the ground that has to be covered by a system that will support data fusion is outlined. Tasks associated with intelligence processing are reviewed. Several views on data fusion are discussed. Various methods and techniques from the areas of databases, artificial intelligence and probability theory that may provide solutions for dealing with some of the problems pertaining to multi-sensor data fusion are presented. ESA

N91-31004 Prins Maurits Lab. TNO, Rijswijk (Netherlands).
HOW TO CREATE AN INSTRUMENTAL DATABASE FOR VERIFICATION: A VIEW Final Report
E. R. J. Wils and P. E. J. Verwiel Nov. 1990 23 p
(Contract A85/D/114)
(PML-1990-80; TD-90-3666; ETN-91-99819) Copyright Avail: Prins Maurits Lab. TNO, P.O. Box 45, 2280 AA Rijswijk ZH, Netherlands

A view on the way an instrumental database should be created for verification purposes is presented. Existing spectrometric and chromatographic data of chemical warfare agents and related compounds should be used for the establishment of such a database. Some general ideas of how to accomplish this are indicated. The relative importance of the vaious instrumental analytical data to be collected and the problem of the distribution of the database are discussed. A survey of the data available of more than 200 compounds is presented in tabular form. ESA

N91-31005# Grenoble-1 Univ. (France). Lab. de Genie Informatique.
A GENERAL LOGIC MODEL FOR INFORMATION RETRIEVAL SYSTEMS. APPLICATION TO THE RIME PROTOTYPE Ph.D. Thesis [UN MODELE LOGIQUE GENERAL POUR LES SYSTEMES DE RECHERCHE D'INFORMATIONS: APPLICATION AU PROTOTYPE RIME]
Jianyun Nie 1990 249 p In FRENCH
(ETN-91-99489) Avail: NTIS HC/MF A11

Two criteria are focused for the evaluation of the correspondance between a domument and a query, e.g., the exhaustivity and the document specified with regard to query. A general model based on fuzzy modal logic is defined for the evaluation of both criteria. This model is compared with existing models, in order to outline its general character. The model

proposed is applied to the query process of the RIME prototype for medical information retrieval. This prototype has a quasi natural language. A query process is divided into two parts: the interpretation of queries in quasi natural language, and query evaluation by using the general model. These two points are studied in detail. A realization, is presented, as well as its experimentaion on a medical corpus. ESA

N91-31006# European Space Agency, Paris (France).
CATALOGUE OF ESA PUBLICATIONS IN 1988
B. Battrick, comp. and F. deZwaan, comp. Aug. 1989 42 p
(ESA-SP-1088; ETN-91-99527) Avail: NTIS HC/MF A03

The publications are listed by category and by subject and document availabilities and charges are given. The ESA bulletin provides information on ESA, its activities and purposes and can be understood by the space interested layman. The ESA journal is a learned publication containing original ESA/European papers on space technology, science, missions, sytems management and operation. Other publications include: specials; brochures; scientific and technical reports and memoranda; procedures, standard and specifications; and contractor reports. ESA

N91-31007# European Space Agency, Paris (France).
CATALOGUE OF ESA PUBLICATIONS IN 1989
B. Battrick, comp. and F. deZwaan, comp. Jun. 1990 45 p
(ESA-SP-1089; ETN-91-99528) Avail: NTIS HC/MF A03

The publications are listed by category and by subject and document availabilities and charges are given. The ESA bulletin provides information on ESA, its actvities and purposes and can be understood by the space interested layman. The ESA journal is a learned publication containing original ESA/European papers on space technology, science, missions, systems mamagement and operation. Other publications include: specials; brochures; scientific and technical reports and memoranda; procedures, standards and specifications; and contractor reports. ESA

N91-31008# Helsinki Univ. of Technology, Espoo (Finland). Faculty of Information Technology.
FORM-BASED APPROACH TO DISTRIBUTED COOPERATIVE WORK Ph.D. Thesis
Heikki Haemmaeinen Helsinki, Finland Finnish Academy of Technology 1991 52 p Sponsored by Finnish Technology Development Center; PTT Finland; and KONE Corp.
(Acta-Polytec-Scand-Ma-58; ISBN-951-666-323-0;
ISSN-0355-2713; ETN-91-99538) Avail: NTIS HC/MF A04

An object oriented form based multiagent model to facilitate the rapid construction of integrated systems for distributed cooperative work is developed. The model consists of autonomous asynchronous event driven user agents managing private formbases and interacting with each other through form interchange. A high degree of abstraction is achieved by unifying the visual appearance, storage, processing, and communication behavior of forms through a generalized form metaclass. As a central contribution, the integration of form classes among cooperating agents is solved locally by means of a special inheritance scheme which allows flexible management of both the private and shared form classes. The conceptual model is implemented as a generic user agent called the Programmable Agents for Group Interaction System (PAGES). The PAGES is used to construct a system called a change management in distributed environment (CHAMADE) which supports the integrated coordination of the formal and informal collaboration on order amendments between salesmen, designers, and engineers along the supply chain in distributed manufacture of one of a kind elevators. The CHAMADE shows that the underlying object-oriented form abstraction facilitates rapid construction of applications which are impossible, or at least impractical, to implement with more conventional tools. In addition, it shows that the throughput time of group task, e.g., change negotiations, can be significantly reduced when using these applications. The expected gross impact of faster group tasks is a shorter overall throughput time of elevators along the supply chain. ESA

N91-31009# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). EXOSAT Observatory.
THE EXOSAT DATABASE SYSTEM: BROWSE VERSION 3.0 USER'S GUIDE
Chris Barron, ed. Feb. 1991 124 p
(ESA-TM-11; ISBN-92-9092-201-X; ISSN-1013-7076;
ETN-91-99557) Copyright Avail: NTIS HC/MF A06; EPD, ESTEC, Noordwijk, Netherlands, HC 40 Dutch guilders

The BROWSE user guide is presented. A background history and associated programs are included in this guide. BROWSE is a command driven program that uses a Database Management System (DBMS) to select data from tables of information and then execute analysis tasks on those data. The program name reflects the fact that it provides astronomers with a tool to browse through large volumes of data, selecting or discarding them as required. Emphasis is placed on data visualization so that an immediate assessment of data quality, source properties, and overall characteristics can be made. BROWSE provides the capability to automatically process and reprocess large volumes of data. To date BROWSE has been used to access Exosat, Einstein and IUE (International Ultraviolet Explorer) data files, as well as many popular astronomical catalogs. Interfaces are provided to the Exosat X-ray astronomy data analysis packages, and to the SAOIMAGE image display and manipulation package. ESA

N91-31010# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). EXOSAT Observatory.
THE EXOSAT DATABASE SYSTEM: ON-LINE USER'S GUIDE
Chris Barron, ed. Feb. 1991 43 p
(ESA-TM-12; ISBN-92-9092-205-2; ISSN-1013-7076;
ETN-91-99558) Copyright Avail: NTIS HC/MF A03; EPD, ESTEC, Noordwijk, Netherlands, HC 20 Dutch guilders

The EXOSAT database system is a mission/telescope independent online astronomical facility created to access and analyze data obtained by the European X-ray astronomy satellite, EXOSAT. Data from other orbiting observatories (e.g., Einstein and IUE) and well known ground based catalogs (e.g., the HST Guide Star and HD Catalogs) can also be remotely accessed using this system. The EXOSAT system has been installed at two sites in Europe (ESTEC and the University of Leicester) and one site in the U.S. (GSFC). How to access and use the on line EXOSAT database system is described in this guide. ESA

N91-31011# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). EXOSAT Observatory.
THE EXOSAT DATABASE SYSTEM: AVAILABLE DATABASES
Chris Barron, ed. Feb. 1991 80 p
(ESA-TM-13; ISBN-92-9092-209-5; ISSN-1013-7076;
ETN-91-99559) Copyright Avail: NTIS HC/MF A05; EPD, ESTEC, Noordwijk, Netherlands, HC 30 Dutch guilders

The databases that are currently available by remote log in to the EXOSAT/ESTEC site of the EXOSAT database system are described in this user guide. Wherever possible the following are included: brief descriptions of each observatory, telescope and instrument; references to more complete observatory descriptions; a list of the contents of each database and how it was generated; parameter descriptions; a contact person with overall responsibility for the database. The databases can be accessed using the BROWSE program. ESA

N91-31012# National Aerospace Lab., Amsterdam (Netherlands). Informatics Div.
DEVELOPMENT OF ISNaS: AN INFORMATION SYSTEM FOR FLOW SIMULATION IN DESIGN
M. E. S. Vogels and W. Loeve 27 Jan. 1989 21 p Presented at Conference on Computer Applications in Production and Engineering, Amsterdam, Netherlands, 9-11 May 1989
(NLR-TP-89025-U; ETN-91-99632) Avail: NTIS HC/MF A03

The development of an information system for (digital) flow simulation based on the Reynolds averaged Navier-Stokes

equations is presented. The system consists of software elements: a method manager and executive for software methods, and a data manager for data representing geometries, grids, and flow results; hardware elements: a mainframe, a vector computer, and workstations in a communication network; information generation methods: geometry handlers, grid generators, flow solvers, and post processors. Attention is paid both to the technical aspects and to the organizational aspects of the project which aims at the cooperative development of software elements of the information system; the method manager and executive, and the flow solvers for Reynolds averaged Navier-Stokes equations. ESA

N91-31013# Universiteit Twente, Enschede (Netherlands). Dept. of Information Systems.
QUALITY ASSURANCE IN THE MANAGEMENT OF INFORMATION SYSTEMS
L. J. B. Essink Dec. 1990 29 p
(Memo-INF-90-90; ISSN-0923-1714; ETN-91-99681) Avail: NTIS HC/MF A03

Quality assurance in relation to the planning development, introduction and maintenance of automated information systems is addressed. Quality is threatened by inadequate organization of the process, the lack of operational quality criteria and misinterpretation of needs. Quality problems are emerging from a number of well known pitfalls of IS (Information Systems) development in practice. These pitfalls give a good indication of 'why information systems fail'. The implementation of a quality system in the organization to monitor organizational structures, the quality of specifications, procedures and processes is a necessity. The needs and structure of such a quality assurance system are outlined. A framework that enables a clear distinction of the different aspects of the management of IS is presented. In the framework different models for analyzing quality requirements and management structures of IS development are treated. The critical success factors of IS development are outlined. The term 'critical success factor' stands for a condition, a control variable or circumstance that has to be managed properly in order to achieve an 'optimal' organizational setting contributing to the success of a development process. ESA

N91-31014# Universiteit Twente, Enschede (Netherlands). Dept. of Information Systems.
OBJECT MODELLING AND SYSTEM DYNAMICS IN THE CONCEPTUALIZATION STAGES OF INFORMATION SYSTEMS DEVELOPMENT
L. B. J. Essink and W. J. Erhart Dec. 1990 33 p
(Memo-INF-90-91; ISSN-0923-1714; ETN-91-99682) Avail: NTIS HC/MF A03

In the conceptualization stages of information systems development, a conceptual model of a universe of discourse (UoD) has to be realized. This model should formalize the meaning and role of the information system in the business environment. The state and state transitions base of the objects that are to be described in the information system (IS) and the dynamic rules that control the lawful state transitions of the system are represented. The Object Event Rule (OER) model of MADIS is explained and the corresponding modeling approach to establish abstraction hierarchies, life cycle specifications, and dynamic rules is outlined. A modern, object oriented methodology for the first stages of information system development is thereby proposed and illustrated with the CRIS case. ESA

N91-31015# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
REPRESENTING COMPLEX OBJECTS IN A DISTRIBUTED DATABASE: A PERFORMANCE EVALUATION
Wouter B. Teeuw and Henk M. Blanken Dec. 1990 21 p
Sponsored in part by Netherlands Organization for Applied Scientific Research, TNO
(Memo-INF-90-92; ISSN-0923-1714; ETN-91-99683) Avail: NTIS HC/MF A03

In order to use database systems in distributed non standard environments, an efficient way to represent and manipulate complex objects in a distributed environment is much needed. Alternatives for representing a complex object in a shared nothing system and analytical performances aspects of these representations are investigated. A distinction is made between 'tuple objects' (that are existence dependent) and 'composed objects' (which share tuple objects). It is shown that inter tuple object parallelism is more promising than intra tuple object parallelism. Also (though dependent on the access pattern), tuple objects are preferably stored in a normalized way on a single node, provided that relations are ordered in a suitable way. ESA

N91-31016# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
CONTROL VERSUS DATA FLOW IN DISTRIBUTED DATABASE MACHINES
Wouter B. Teeuw and Henk M. Blanken 2 Jan. 1991 27 p
Sponsored in part by Netherlands Organization for Applied Scientific Research, TNO
(Memo-INF-91-02; ISSN-0923-1714; ETN-91-99684) Avail: NTIS HC/MF A03

A query in a distributed database machine may be executed in a control flow way (a single node managing the whole execution) or in a data flow way (every node handles some control tasks). Control and data flow are compared and some systems using data flow are described. It appears that data flow reduces the number of control messages (though possibly only slightly) and balances these messages over all nodes. The number of data messages is not reduced. Besides data, flow is less flexible, synchronization is more complex, and node failures are harder to detect. Nevertheless, to some types of queries data flow is very attractive. ESA

N91-31017# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.
PRISMA/DB 1.0 USER MANUAL
Paul W. P. J. Grefen, Annita N. Wilschut, and Jan Flokstra Jan. 1991 51 p
(Memo-INF-91-06; ISSN-0923-1714; ETN-91-99688) Avail: NTIS HC/MF A04

The PRISMA/DB is an experimental relational database management system employing parallelism and relation fragmentation to obtain high performance. A complete user manual of the PRISMA/DB system, including the full description of the primary data definition and manipulation languages, eXtended data definition and eXtended relational algebra is presented. An extensive bibliography with references to work related to PRISMA/DB is included. ESA

83 ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

N91-31018# Air Force Inst. of Tech., Wright-Patterson AFB, OH.
AN INVESTIGATION OF THE STABILITY OF THE COST PERFORMANCE INDEX M.S. Thesis
Kirk I. Payne Sep. 1990 86 p
(AD-A229498; AFIT/GCA/LSY/90S-6) Avail: NTIS HC/MF A05 CSCL 05/3

This study examines the stability of the Cost Performance Index (CPI). The CPI is an indicator of the cost performance efficiency achieved on a contract and is used to analyze cost performance on defense contracts. It has long been asserted that the index does not change by more than 10 percent after a contract is 50 percent complete, but an exhaustive literature search did not locate any empirical work that supports this assertion. Knowing that the CPI is stable is important because it indicates that a contractor has a healthy management system, it increases the reliability placed in the contractor's planning process, it gives confidence in our Estimate at Completion computations, and if a contractor is overrunning his budget, it gives confidence when declaring the contractor in trouble. After defining CPI stability two

methods to test for stability were developed. The two methods chosen were first, to measure the range of the CPIs that occurred at greater than 50 percent complete and second, to calculate a percentage interval and verify that the CPI is stable after a contract is 50 percent complete. GRA

N91-31019# Air Force Inst. of Tech., Wright-Patterson AFB, OH.
AN INTERACTIVE LIFE CYCLE COST FORECASTING TOOL M.S. Thesis
John A. Gibson, IV Mar. 1991 151 p
(AD-A238352; AFIT/GOR/ENS/91M-5) Avail: NTIS HC/MF A08 CSCL 05/3

Enhancements were applied to an existing tool designed to estimate life cycle costs. These enhancements provide greater ease of data manipulation, additional options in developing models, and the ability to make modifications to suit the needs of the user. Life cycle costs can be generated quickly and easily. Analysis proved the amount of work done by the computer could be reduced with no loss of information. Additionally, the paths available to the user are shown graphically through flow charts, aiding in the learning process. The efforts of the user can now be directed towards developing models instead of spending those efforts on deciphering how to make the tool work. GRA

84 LAW, POLITICAL SCIENCE AND SPACE POLICY

Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.

N91-31020# Wichita State Univ., KS. National Inst. for Aviation Research.
A BRIEF EXAMINATION AND COMPARISON BETWEEN THE FEDERAL MOTOR VEHICLE SAFETY STANDARDS AND THE FEDERAL AVIATION REGULATIONS
Brian Steele and Hamid Lankarani 1991 78 p
(NIAR-91-25) Avail: NTIS HC/MF A05

A brief examination of the National Highway Traffic Safety Administration's (NHTSA) and the Federal Aviation Administration's (FAA) standards regarding passenger safety restraint systems. The HNTSA's standards are contained in the Federal Motor Vehicle Safety Standards (FMVSS) and those of the FAA are in the Federal Aviation Regulations (FAR). A comparison of the two agencies' regulations and some general recommendations to improve them are included. Author

N91-31021# Technische Univ., Berlin (Germany, F.R.). Fachgebiet Raumfahrtplanung.
COST EFFECTIVENESS ANALYSIS OF ALTERNATIVE PROGRAMS FOR EUROPEAN PARTICIPATION IN LUNAR DEVELOPMENT [KOSTEN-WIRKSAMKEITS-ANALYSE ALTERNATIVER PROGRAMME ZUR EUROPAEISCHER BETEILIGUNG AN DER ERSCHLIESSUNG DES MONDES]
Oliver Todt 1 Dec. 1990 81 p In GERMAN; ENGLISH summary
(ILR-Mitt-251(1990); ETN-91-99460) Avail: NTIS HC/MF A05

The benefits derived from the alternative programs are determined, using a European system of objectives, in order to measure the cost effectiveness. The benefits are compared to program costs. The results suggest that the only sensible way for Europe to proceed is through international cooperation. Two kinds of possible organizations are described. One is similar to the program for Freedom Space Station, the other one is based on an international consortium. These two programs would lead to an initial operating capability around 2010. Lunar installations would house crews of 15 and 35 on average. The life cycle costs for these programs are estimated to be 40 and 77 billions Accounting Units (AU) respectively by 2050. ESA

85 URBAN TECHNOLOGY AND TRANSPORTATION

Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.

For related information see also *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

N91-31022*# Garrett Turbine Engine Co., Phoenix, AZ.
ADVANCED TURBINE TECHNOLOGY APPLICATIONS PROJECT (ATTAP) Annual Report, 1990
Mar. 1991 187 p
(Contract DEN3-335)
(NASA-CR-187146; DOE/NASA/0335-3; NAS 1.26:187146; Garrett-31-8071(3)) Avail: NTIS HC/MF A09 CSCL 21E

This report summarizes work performed in support of the development and demonstration of a structural ceramic technology for automotive gas turbine engines. The AGT101 regenerated gas turbine engine developed under the previous DOE/NASA Advanced Gas Turbine (AGT) program is being utilized for verification testing of the durability of next-generation ceramic components and their suitability for service at reference powertrain design conditions. Topics covered in this report include ceramic processing definition and refinement, design improvements to the test bed engine and test rigs, and design methodologies related to ceramic impact and fracture mechanisms. Appendices include reports by ATTAP subcontractors addressing the development of silicon nitride and silicon carbide families of materials and processes. Author

N91-31023*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
STATUS OF THE ADVANCED STIRLING CONVERSION SYSTEM PROJECT FOR 25 kW DISH STIRLING APPLICATIONS Final Report
Richard K. Shaltens and Jeffrey G. Schreiber 1991 11 p Presented at the 26th Intersociety Energy Conversion Engineering Conference, Boston, MA, 4-9 Aug. 1991; cosponsored by ANS, SAE, ACS, AIAA, ASME, IEEE, and AIChE
(Contract DE-AI04-85AL-33408)
(NASA-TM-104528; E-6404; DOE/NASA/33408-5; NAS 1.15:104528) Avail: NTIS HC/MF A03 CSCL 10B

Heat engines were evaluated for terrestrial Solar Distributed Heat Receivers. The Stirling engine was identified as one of the most promising heat engines for terrestrial applications. Technology development is also conducted for Stirling convertors directed toward a dynamic power source for space applications. Space power requirements include high reliability with very long life, low vibration, and high system efficiency. The free-piston Stirling engine has the potential for future high power space conversion systems, either nuclear or solar powered. Although both applications appear to be quite different, their requirements complement each other. Author

88 SPACE SCIENCES (GENERAL)

N91-31024*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
CRYO-MECHANICAL TESTS OF AMES 24E2 IR-BLACK COATING
Sheldon M. Smith Jun. 1991 15 p Presented at the SPIE International Symposium, San Diego, CA, 8-13 Jul. 1990
(NASA-TM-102863; A-90279; NAS 1.15:102863) Avail: NTIS HC/MF A03 CSCL 07C

In addition to the ambient condition tape test, five mechanical tests of the IR-black coating, Ames 24E2, were performed at either liquid helium or liquid nitrogen temperatures. Tensile strain in the coating at liquid nitrogen temperature was measured up to values of 4E-3, both before and after the coating was cycled down to

liquid helium temperature. When applied to an aluminum substrate which was then bent in liquid nitrogen, the aluminum substrate always failed (permanently deformed) well before the coating failed. Sinusoidal accelerations up to 45 Gs in liquid nitrogen and 25 Gs in liquid helium did not crack or otherwise visibly damage the coating. Both sinusoidal and random acceleration at about 90 K of a representative baffle vane structure, at frequencies from 10 to 2000 Hz and up to 15 Gs, did not damage the coating, even at the intersection of a baffle with the telescope tube. Thus on a macroscopic level, cryogenic cooling and various levels of acceleration and strain did not affect this coating. However, on a microscopic scale, some loose particles were found associated with several tests. Outgassing data are also given. Author

N91-31025# European Space Agency, Paris (France).
SYMPOSIUM FOR REIMAR LUEST
Norman Longdon, comp. Feb. 1991 49 p Symposium held in Paris, France, 27 Sep. 1990
(ESA-SP-325; ISBN-92-9092-142-0; ETN-91-99899) Copyright
Avail: NTIS HC/MF A03; ESA, EPD, ESTEC, Noordwijk, Netherlands

The work of Reimar Luest is considered. The future of space research and global cooperation in science is discussed. After a welcome address by Francesco Carassa, papers with the following titles were presented: Reimar Luest: The Astronomer (Rudolf Kippenhahn); Reimar Luest: The Space Scientist (Jacques Blamont); The Political Point of View (Hans Hilger Hauschild); Reminiscences of a Fellow Scientist (Lodewijk Woltjer); The View from Industry (Hans L. Merkmle); Reimar Luest: De l'ESRO a l'ESA (Hubert Curien); The Future of Space Exploration of the Solar System (Roald Sagdeev); The Future of Astrophysics from Space (Martin J. Rees); The Outer Planets and the Heliosphere (James A. Van Allen); The International Cooperation for the Future of Space Science (Monoru Oda). ESA

89 ASTRONOMY

Includes radio, gamma-ray, and infrared astronomy, and astrometry.

N91-31026*# Columbia Univ., New York, NY. Astrophysics Lab.
SEARCH FOR CORRELATED UV AND X RAY ABSORPTION OF NGC 3516 Final Technical Report, 15 Jun. 1989 - 31 Dec. 1990
Christopher Martin, Jules P. Halpern, and Michiel Kolman Aug. 1991 38 p
(Grant NAG5-1140)
(NASA-CR-188711; NAS 1.26:188711; CAL-1911) Avail: NTIS HC/MF A03 CSCL 03A

NGC 3516, a low-luminosity Seyfert galaxy, is one of a small fraction of Seyfert galaxies that exhibit broad absorption in a resonance line. In order to determine whether the UV and x ray absorption in NGC 3516 are related, 5 IUE observations were obtained, quasi-simultaneously with 4 Ginga observations. The results are presented and discussed. The following subject areas are covered: short-term UV variability; emission lines; galactic absorption lines; the C IV, N V, and Si IV absorption features; lower limit on the carbon column density; estimate of the distance from the absorber to the continuum source; variability in the continuum and absorption; a comparison with BAL QSO's; and the x ray-UV connection. Author

N91-31027 Harvard Univ., Cambridge, MA.
A SEARCH FOR DISTANT STARS IN THE MILKY WAY GALAXY'S HALO AND THICK DISK Ph.D. Thesis
Ken Croswell 1990 394 p
Avail: Univ. Microfilms Order No. DA9113149

Two-hundred forty-seven faint stars were observed near the North Galactic Pole. Most of these stars are distant, lying in either the Galactic halo of thick disk, and allow a study of these two populations in situ, with no kinematic of metallicity bias. For all stars spectra yield velocities, and for over half stars, Stroemgren photometry gives luminosities, distances, and metallicities. Even though it was selected with no kinematic or metallicity criteria, the sample consists predominantly of thick disk and halo stars: the velocity dispersion of the total sample is 62 km/sec. Dissert. Abstr.

N91-31028 Wales Univ. Inst. of Science and Technology, Cardiff.
VISIBILITY AND THE SELECTION OF GALAXIES Ph.D. Thesis
J. I. Davies 1989 164 p
Avail: Univ. Microfilms Order No. BRDX92064

Galaxy catalogues are often described as being complete to some limiting magnitude or limiting size. Statements of this kind are misleading as the inclusion of a galaxy in a catalogue depends critically on its surface brightness. How surface brightness effects may bias the view of the galaxy population is discussed. Simulating a large sample of galaxies with a wide range of intrinsic properties shows that galaxies with a preferred value of surface brightness (dependent on the selection criteria) can be observed to larger distances; they are more visible. Catalogue limiting magnitudes and sizes are probably related through signal to noise constraints to give a preferred surface brightness that is approximately the same as the observed. The standard view of a narrow range of surface brightness is inconsistent with the observational data. A model with galaxies having a wide range of surface brightness is in reasonably good agreement with the observations. To support the above conjectures a sample of low surface brightness galaxies is described, stressing in particular the importance of well defined selection criteria. A further possible constraint on the observed surface brightness of galaxies is an optical depth effect. It is shown how dust absorption in galactic discs may restrict the range of surface brightnesses observed, and how it may lead to a significant underestimate of both disc and bulge light. Dissert. Abstr.

N91-31029*# Columbia Univ., New York, NY.
IUE AND ROSAT MONITORING OF THE BRIGHT QSO H1821+643 Final Technical Report, 1 Sep. 1990 - 31 Aug. 1991
Jules Halpern, Michiel Kolman, Chris Shrader, and Alexei Filippenko Aug. 1991 32 p
(Grant NAG5-1425)
(NASA-CR-188719; NAS 1.26:188719; CAL-1913) Avail: NTIS HC/MF A03 CSCL 03A

The analysis is presented of IUE observations of the bright QSO H1821+643, obtained during the ROSAT All Sky Survey (the RIASS program). The objectives were: (1) to establish whether the UV and soft X ray radiation have the same physical origin; and (2) to determine if this physical origin is an accretion disk. Supporting ground based spectrophotometry was also obtained. The analysis shows that the shape and flux level of the UV continuum did not vary among the seven IUE observation spanning one month, to an upper limit of about 8 percent. So it is of great interest to determine whether the soft X ray flux varied during this period. Since X ray variability in AGNs is often more rapid and of higher amplitude than in the UV, detection of X ray variability in the ROSAT data could severely challenge the accretion disk model for the soft X ray excess. Author

N91-31030*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
THE US NAVAL OBSERVATORY ZODIACAL ZONE CATALOG (DOUGLAS AND HARRINGTON 1990): DOCUMENTATION FOR THE MACHINE-READABLE VERSION
Wayne H. Warren, Jr. Jun. 1990 15 p
(NASA-TM-105050; NSSDC/WDC-A-R/S-90-15; NAS 1.15:105050) Avail: NTIS HC/MF A03 CSCL 03A

The machine readable version of the catalog, as it is currently being distributed from the Astronomical Data Center, is described. The Zodiacal Zone Catalog is a catalog of positions and proper motions for stars in the magnitude range where m sub v is between 4 and 10, lying within 16 deg of the ecliptic and north of declination -30 deg. The catalog contains positions and proper motions, at

epoch, for equator and equinox J2000.0, magnitudes and spectral types taken mostly from the Smithsonian Astrophysical Observatory Star Catalog, and reference positions and proper motions for equinox and epoch B1950.0. Author

N91-31031*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
LICK SATURN-VOYAGER REFERENCE STAR CATALOGUE (KLEMOLA, TARAJI, AND OCAMPO 1979): DOCUMENTATION FOR THE MACHINE-READABLE VERSION
Wayne H. Warren, Jr. Feb. 1990 13 p
(NASA-TM-105047; NSSDC/WDC-A-R/S-90-05; NAS 1.15:105047) Avail: NTIS HC/MF A03 CSCL 03A

The machine readable version of the catalog, as it is currently being distributed from the Astronomical Data Center, is described. The catalog contains accurate equatorial coordinates for 4551 stars in a band of sky against which cameras of the Voyager spacecraft were pointed for observations in the region of Saturn during the flyby. All of the reference stars are in the range 12(exp h) 40(exp m) to 14(exp h) 12(exp m) in right ascension (1950) and +02 to -09 degs in declination. Mean errors of the positions are about 0.25 sec. Author

N91-31032*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
LICK JUPITER-VOYAGER REFERENCE STAR CATALOGUE (KLEMOLA, MORABITO, AND TARAJI 1978): DOCUMENTATION FOR THE MACHINE-READABLE VERSION
Wayne H. Warren, Jr. Feb. 1990 13 p
(NASA-TM-105092; NSSDC/WDC-A-R/S-90-04; NAS 1.15:105092) Avail: NTIS HC/MF A03 CSCL 03A

The machine-readable version of the catalog, as it is currently being distributed from the Astronomical Data Center, is described. The catalog contains accurate equatorial coordinates for 4983 stars in a band of sky against which cameras of the Voyager spacecraft were pointed for observations in the region of Jupiter during the flyby. All of the reference stars are in the range 6 hr 00 min to 8 hr 04 min in right ascension (1950), declination zones +16 to +23 degrees, and 8 hr to 31 min to 8 hr 57 min, zones +08 to +14 degrees. Mean errors of the positions are about 0.4 sec. Author

N91-31033*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
A CATALOG OF STELLAR SPECTROPHOTOMETRY (ADELMAN, ET AL. 1989): DOCUMENTATION FOR THE MACHINE-READABLE VERSION
Wayne H. Warren, Jr. and Saul J. Adelman Jan. 1990 17 p
(NASA-TM-105045; NSSDC/WDC-A-R/S-90-03; NAS 1.15:105045) Avail: NTIS HC/MF A03 CSCL 03A

The machine-readable version of the catalog, as it is currently being distributed from the astronomical data centers, is described. The catalog is a collection of spectrophotometric observations made using rotating grating scanners and calibrated with the fluxes of Vega. The observations cover various wavelength regions between about 330 and 1080 nm. Author

N91-31034*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
FIFTH FUNDAMENTAL CATALOGUE (FK5). PART 1: BASIC FUNDAMENTAL STARS (FRICKE, SCHWAN, AND LEDERLE 1988): DOCUMENTATION FOR THE MACHINE-READABLE VERSION
Wayne H. Warren, Jr. Jan. 1990 15 p
(NASA-TM-105043; NSSDC/WDC-A-R/S-90-01; NAS 1.15:105043) Avail: NTIS HC/MF A03 CSCL 03A

The machine-readable version of the catalog, as it is currently being distributed from the Astronomical Data Center, is described. The Basic FK5 provides improved mean positions and proper motions for the 1535 classical fundamental stars that had been included in the FK3 and FK4 catalogs. The machine version of the catalog contains the positions and proper motions of the Basic FK5 stars for the epochs and equinoxes J2000.0 and B1950.0, the mean epochs of individual observed right ascensions and declinations used to determine the final positions, and the mean errors of the final positions and proper motions for the reported epochs. The cross identifications to other designations used for the FK5 stars that are given in the published catalog were not included in the original machine versions, but the Durchmusterung numbers have been added at the Astronomical Data Center. Author

N91-31035*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
SECOND CATALOG OF INTERFEROMETRIC MEASUREMENTS OF BINARY STARS (MCALISTER AND HARTKOPF 1988): DOCUMENTATION FOR THE MACHINE-READABLE VERSION
Wayne H. Warren, Jr. Jun. 1989 39 p
(NASA-TM-105065; NSSDC/WDC-A-R/S-89-09; NAS 1.15:105065) Avail: NTIS HC/MF A03 CSCL 03A

The machine-readable version of the catalog, as it is currently being distributed from the Astronomical Data Center, is described. The catalog is a compilation of measurements of binary- and multiple-star systems obtained by speckle interferometric techniques; this version supersedes a previous edition of the catalog published in 1985. Stars that have been examined for multiplicity with negative results are included, in which case upper limits for the separation are given. The second version is expanded from the first in that a file of newly resolved systems and six cross-index files of alternate designations are included. The data file contains alternate identifications for the observed systems, epochs of observation, reported errors in position angles and separation, and bibliographical references. Author

N91-31036*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
SMITHSONIAN ASTROPHYSICAL OBSERVATORY (SAO) STAR CATALOG (SAO STAFF 1966, EDITION ADC 1989): DOCUMENTATION FOR THE MACHINE-READABLE VERSION
Nancy G. Roman and Wayne H. Warren, Jr. Jun. 1989 29 p
(NASA-TM-105064; NSSDC/WDC-A-R/S-89-08; NAS 1.15:105064) Avail: NTIS HC/MF A03 CSCL 03A

An updated, corrected, and extended machine readable version of the catalog is described. Published and unpublished errors discovered in the previous version were corrected, and multiple star and supplemental BD identifications were added to stars where more than one SAO entry has the same Durchmusterung number. Henry Draper Extension (HDE) numbers were added for stars found in both volumes of the extension. Data for duplicate SAO entries (those referring to the same star) were flagged. J2000 positions in usual units and in radians were added. Author

N91-31037*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
SOUTHERN DURCHMUSTERUNG (SCHOENFELD 1886): DOCUMENTATION FOR THE MACHINE-READABLE VERSION
Wayne H. Warren, Jr. and Francois Ochsenbein (Observatoire de Strasbourg, France) Apr. 1989 17 p
(NASA-TM-105062; NSSDC/WDC-A-R/S-89-06; NAS 1.15:105062) Avail: NTIS HC/MF A03 CSCL 03A

The machine-readable version of the catalog, as it is currently being distributed from the Astronomical Data Center, is described. The Southern Durchmusterung (SD) was computerized at the Centre de Donnees Astronomiques de Strasbourg and at the Astronomical Data Center at the National Space Science Data Center, NASA/Goddard Space Flight Center. Corrigenda listed in the original SD volume and published by Kuenster and Sticker were incorporated into the machine file. In addition, one star indicated to be missing in a published list, and later verified, is flagged so that it can be omitted from computer plotted charts if desired. Stars deleted in the various errata lists were similarly flagged, while those with revised data are flagged and listed in a separate table. This catalog covers the zones -02 to -23 degrees; zones +89 to -01 degrees (the Bonner Durchmusterung) are included in a separate catalog available in machine-readable form. Author

N91-31038*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
BONNER DURCHMUSTERUNG (ARGELANDER 1859-1862): DOCUMENTATION FOR THE MACHINE-READABLE VERSION
Wayne H. Warren, Jr. and Francois Ochsenbein (Observatoire de Strasbourg, France) Apr. 1989 30 p
(NASA-TM-105061; NSSDC/WDC-A-R/S-89-05; NAS 1.15:105061) Avail: NTIS HC/MF A03 CSCL 03A

The machine-readable version of the catalog, as it is currently being distributed from the Astronomical Data Center, is described. The entire Bonner Durchmusterung (BD) was computerized through the collaborative efforts of the Centre de Donnees Astronomiques de Strasbourg, l'Observatoire de Nice, and the Astronomical Data Center at the NASA/Goddard Space Flight Center. All corrigenda published in the original BD volumes were incorporated into the machine file, along with changes published following the 1903 edition. In addition, stars indicated to be missing in published lists and verified by various techniques are flagged so that they can be omitted from computer plotted charts if desired. Stars deleted in the various errata lists were similarly flagged, while those with revised data are flagged and listed in a separate table. Author

N91-31039*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
A COMPILATION OF REDSHIFTS AND VELOCITY DISPERSIONS FOR ABELL CLUSTERS (STRUBLE AND ROOD 1987): DOCUMENTATION FOR THE MACHINE-READABLE VERSION
Wayne H. Warren, Jr. Jan. 1989 23 p
(NASA-TM-105060; NSSDC/WDC-A-R/S-89-01; NAS 1.15:105060) Avail: NTIS HC/MF A03 CSCL 03A

The machine readable version of the compilation, as it is currently being distributed from the Astronomical Data Center, is described. The catalog contains redshifts and velocity dispersions for all Abell clusters for which these data had been published up to 1986 July. Also included are 1950 equatorial coordinates for the centers of the listed clusters, numbers of observations used to determine the redshifts, and bibliographical references citing the data sources. Author

N91-31040*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
A SEARCH FOR ULTRAVIOLET-EXCESS OBJECTS (KONDO, NOGUCHI, AND MAEHARA 1984): DOCUMENTATION FOR THE MACHINE-READABLE VERSION
Wayne H. Warren, Jr. Nov. 1990 14 p
(NASA-TM-105057; NAS 1.15:105057; NSSDC/WDC-A-R/S-90-26) Avail: NTIS HC/MF A03 CSCL 03A

A list of 1186 ultraviolet-excess objects (designated KUV) was compiled as a result of a search conducted with the 105-cm Schmidt telescope of the Kiso station of the Tokyo Astronomical Observatory. This document describes the machine readable version of the KUV survey list and presents a sample listing showing the logical records as they are recorded in the machine readable catalog. The KUV data include equatorial coordinates, magnitudes, color indices, and identifications for previously cataloged objects. Author

N91-31041*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
A MULTIPLET TABLE FOR Mn I (ADELMAN, SVATEK, VAN WINKLER, WARREN 1989): DOCUMENTATION FOR THE MACHINE-READABLE VERSION
Wayne H. Warren, Jr. and Saul J. Adelman (Citadel Coll., Charleston, SC.) Aug. 1989 17 p
(NASA-TM-105067; NSSDC/WDC-A-R/S-89-13; NAS 1.15:105067) Avail: NTIS HC/MF A03 CSCL 03A

The machine-readable version of the multiplet table, as it is currently being distributed from the Astronomical Data Center, is described. The computerized version of the table contains data on excitation potentials, J values, multiplet terms, intensities of the transitions, and multiplet numbers. Files ordered by multiplet and by wavelength are included in the distributed version. Author

N91-30172# Joint Publications Research Service, Arlington, VA.
RESULTS FROM STUDY OF X RAY PULSARS BY ASTRON OBSERVATORY
V. G. Kurt and Ye. Yu. Shafer *In its* JPRS Report: Science and Technology. USSR: Space 26 Jun. 1991 p 10-12 Transl. into ENGLISH from Zemlya i Vselennaya, Moscow (USSR), no. 6, Nov.-Dec. 1990 p 3-12 (For primary document see N91-30170 22-12)
Avail: NTIS HC/MF A04

90 ASTROPHYSICS

Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.
For related information see also *75 Plasma Physics*.

N91-31042 California Univ., Los Angeles.
EXTENDED FAR-INFRARED EMISSION FROM EVOLVED STARS AND PLANETARY NEBULAE Ph.D. Thesis
George William Hawkins 1990 267 p
Avail: Univ. Microfilms Order No. DA9115422

Red giants, supergiants, and planetary nebulae return more matter to the interstellar medium than supernovae, and studies of their mass loss are important for understanding stellar evolution and the chemical evolution of the galaxy. Extended far infrared emission provides the longest time record from which to study variable mass loss. The method of Sopka et al. is used to study the dust emissivity and radial dependence of dust density in circumstellar envelopes from the far infrared sizes. The far infrared sizes of 57 planetary nebulae, most with 20 to 60 inch optical diameter, are derived from deconvolutions of 1-D survey mode scans of the IRAS. The far infrared diameters of most are similar to their optical diameters, and no large far infrared halos are directly detected. Large diameter IRAS emission was discovered around the nearby red giants W Hya, R Dor, O Cet, and RX Boo. Observations and models show that extended IRAS emission results not from stars with high mass loss rates, but from stars where the mass loss rate has recently declined. A few extended IRAS stars were observed at 50 and 100 microns with the Kuiper Airborne Observatory with a high spatial resolution photometer. Most evolved stars observed with KAO were not resolved. Dissert. Abstr.

N91-31043*# Fermi National Accelerator Lab., Batavia, IL.
PERTURBATIONS FROM COSMIC STRINGS IN COLD DARK MATTER
Andreas Albrecht and Albert Stebbins Jul. 1991 17 p Sponsored in part by DOE
(Grant NAGw-1340)
(NASA-CR-188700; NAS 1.26:188700; FERMILAB-Pub-91/17-A)
Avail: NTIS HC/MF A03 CSCL 03B

A systematic linear analysis of the perturbations induced by cosmic strings in cold dark matter is presented. The power spectrum is calculated and it is found that the strings produce a great deal of power on small scales. It is shown that the perturbations on interesting scales are the result of many uncorrelated string motions, which indicates a much more Gaussian distribution than was previously supposed. Author

N91-31044*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
THE 1983 TAIL-ERA DATA SERIES. VOLUME 4: GOES 5 AND GOES 6 GEOSYNCHRONOUS MAGNETIC FIELD DATA
D. H. Fairfield and K. Takahashi (Johns Hopkins Univ., Laurel, MD.) Mar. 1991 252 p
(NASA-TM-105040; NAS 1.15:105040; NSSDC/WDC-A-R/S-91-07-Vol-4) Avail: NTIS HC/MF A12 CSCL 03B

Twenty-four hour plots are presented of approximately 1-min average magnetic fields from the GOES 5 and GOES 6 spacecraft for the period January 1 to September 4, 1983, with the exception that GOES 6 was not available for the first five months of 1983. Data are displayed in a VDH coordinate system based on a centered dipole with Northern Hemisphere geographic coordinates of the pole at 78.80 deg latitude and 289.24 deg longitude. Magnetic local times are shown along the upper horizontal axis and universal time and dipole tilt angles along the bottom horizontal axis. Author

N91-31045*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
THE 1983 TAIL-ERA DATA SERIES. VOLUME 3: GEOSYNCHRONOUS PARTICLE MEASUREMENTS
D. H. Fairfield and T. E. Cayton (Los Alamos National Lab., NM.) Jan. 1991 566 p
(NASA-TM-105038; NAS 1.15:105038; NSSDC/WDC-A-R/S-91-03-Vol-3) Avail: NTIS HC/MF A24 CSCL 03B

Geosynchronous particle measurements are presented for comparison with same-scale plots of ISEE 3 plasma and field data. Shown for each day are electron and proton fluxes measured with the low-energy-range electron and the low-energy-range proton detectors of the Los Alamos Charged Particle Analyzer. This instrument has flown aboard several geosynchronous orbit satellites, including the three spacecraft from which the presented data were obtained. The presented data are 5-min averages of the integral flux in each of several energy channels. Author

N91-31046*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
THE 1983 TAIL-ERA DATA SERIES. VOLUME 2: ISEE 3 MAGNETIC FIELD
D. H. Fairfield and J. L. Phillips (Los Alamos National Lab., NM.) Apr. 1990 134 p
(NASA-TM-105049; NSSDC/WDC-A-R/S-90-12-Vol-2; NAS 1.15:105049) Avail: NTIS HC/MF A07 CSCL 03B

ISEE 3 spacecraft measurements within and near the Earth's magnetic tail is presented. Plots are shown of ISEE 3 magnetic field data. The plots in this volume showing observations from the ISEE 3 vector helium magnetometer experiment were produced from a tape of merged plasma/magnetic field data. The magnetometer produced six vector measurements/sec that were subsequently averaged over one minute intervals before merging with plasma data. Merging was accomplished by associating the nearest 1 minute field average with each plasma sample. Author

N91-31047*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
THE 1983 TAIL-ERA SERIES. VOLUME 1: ISEE 3 PLASMA
D. H. Fairfield and J. L. Phillips (Los Alamos National Lab., NM.) Apr. 1991 260 p
(NASA-TM-105048-Vol-1; NAS 1.15:105048-Vol-1; NSSDC/WDC-A-R/S-90-11-Vol-1) Avail: NTIS HC/MF A12 CSCL 03B

Observations from the ISEE 3 electron analyzer are presented in plots. Electrons were measured in 15 continuous energy levels between 8.5 and 1140 eV during individual 3-sec spacecraft spins. Times associated with each data point are the beginning time of the 3 sec data collection interval. Moments calculated from the measured distribution function are shown as density, temperature, velocity, and velocity azimuthal angle. Spacecraft ephemeris is shown at the bottom in GSE and GSM coordinates in units of Earth radii, with vertical ticks on the time axis corresponding to the printed positions. Author

N91-31048*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
PROMIS SERIES. VOLUME 8: MIDLATITUDE GROUND MAGNETOGRAMS
D. H. Fairfield and C. T. Russell (California Univ., Los Angeles.) Apr. 1990 104 p
(NASA-TM-105048-Vol-8; NAS 1.15:105048-Vol-8; NSSDC/WDC-A-R/S-90-10-Vol-8) Avail: NTIS HC/MF A06 CSCL 03B

This is the eighth in a series of volumes pertaining to the Polar Region Outer Magnetosphere International Study (PROMIS). This volume contains 24 hour stack plots of 1-minute average, H and D component, ground magnetograms for the period March 10 through June 16, 1986. Nine midlatitude ground stations were selected from the UCLA magnetogram data base that was constructed from all available digitized magnetogram stations. The primary purpose of this publication is to allow users to define universal times and onset longitudes of magnetospheric substorms. M.G.

N91-31049*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
PROMIS SERIES. VOLUME 7: GOES 5 AND GOES 6 GEOSYNCHRONOUS MAGNETIC FIELD DATA FOR MARCH - JUNE 1986
D. H. Fairfield and K. Takahashi (Johns Hopkins Univ., Laurel, MD.) Nov. 1989 104 p
(NASA-TM-105072; NAS 1.15:105072; NSSDC/WDC-A-R/S-89-22) Avail: NTIS HC/MF A06 CSCL 03B

This is the seventh in a series of volumes pertaining to the Polar Region Outer Magnetosphere International Study (PROMIS). This volume contains 24 hour plots of approximately 1-minute average magnetic fields from the GOES 5 and GOES 6 spacecraft for the period March 10 through June 16, 1986. Data are displayed in a VDH coordinate system based on a centered dipole with northern hemisphere geographic coordinates of the pole at 78.80 deg latitude and 289.24 deg longitude. M.G.

N91-31050 Texas Univ., Austin.
PECULIAR COSMOLOGICAL VELOCITIES Ph.D. Thesis
Caroline Maria Lewis 1990 70 p
Avail: Univ. Microfilms Order No. DA9116908

A gauge invariant, variational formalism for investigating vector perturbations is set up, suitable for showing that there is no natural way that the usual scalar inflation field could give rise to vorticities. Also, a vector field is coupled to the Einstein equations with a linearly perturbed Friedmann-Robertson-Walker (FRW) metric, constructed to generate first order vector perturbations. A working classical chaotic vector inflation is demonstrated and then quantum fluctuations of the field are used to constrain the cosmological perturbations. In particular, the vector momentum flux is tracked to the epoch where a radiation dominated matter exists. Matching conditions using observational constraints of the cosmic microwave background radiation (CMBR) gives rise to a peculiar cosmological velocity of the order of 10(exp -100) c. Amplification of this number, e.g., by breaking the conformal invariance of the field, could be used to generate cosmic magnetic fields using a dynamo mechanism. Dissert. Abstr.

N91-31051*# Alabama Univ., University.
THE ROLE OF UV-OPTICAL OBSCURATION IN STARBURST GALAXIES Final Technical Report
William C. Keel 6 Sep. 1991 11 p
(Grant NAG5-1386)
(NASA-CR-188771; NAS 1.26:188771) Avail: NTIS HC/MF A03 CSCL 03B

The starburst phenomenon was viewed as increasingly important since the recognition that some galaxies have regions in which stars are forming so rapidly that a transient event must be seen. Such starbursts populate samples of galaxies selected either for UV or IR excess, and some were found from IRAS source identifications that must be quite heavily obscured at optical wavelengths. Many interpretations of the physical conditions in these objects and their stellar populations have relied on scaling from models of individual H II regions, and this certainly seems justified from the gross appearance of the optical spectra and IR spectral shapes. Collection of complementary UV, optical, and

near-IR data is presented on a set of starbursts, with a preliminary analysis of models for more realistic internal structure. Author

N91-31052*# Rice Univ., Houston, TX. Dept. of Space Physics and Astronomy.
MODELING THE SURFACE AND INTERIOR STRUCTURE OF COMET NUCLEI USING A MULTIDISCIPLINARY APPROACH Final Technical Report, 1 May 1989 - 30 Sep. 1991
C. R. ODell, Panos C. Dakoulas, and George M. Pharr 30 Sep. 1991 14 p
(Grant NAG9-358)
(NASA-CR-188635; NAS 1.26:188635) Avail: NTIS HC/MF A03 CSCL 03B

The goal was to investigate the structural properties of the surface of comet nucleus and how the surface should change with time under effect of solar radiation. The basic model that was adopted was that the nucleus is an aggregate of frosty particles loosely bound together, so that it is essentially a soil. The nucleus must mostly be composed of dust particles. The observed mass ratios of dust to gas in the coma is never much greater than unity, but this ratio is probably a much lower limit than that of the nucleus because it is vastly easier to remove the gaseous component by sublimation than by carrying off the dust. Therefore the described models assumed that the particles in the soil were frost covered grains of submicron basic size, closely resembling the interstellar grains. The surface properties of such a nucleus under the effects of heating and cooling as the nucleus approaches and recedes from the Sun generally characterized. Author

91 LUNAR AND PLANETARY EXPLORATION

Includes planetology; and manned and unmanned flights. For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance.*

N91-31053*# Georgia Inst. of Tech., Atlanta. School of Electrical Engineering.
MILLIMETER-WAVE SPECTRA OF THE JOVIAN PLANETS
Joanna Joiner and Paul G. Steffes Aug. 1991 149 p
(Grant NAGw-533)
(NASA-CR-188712; NAS 1.26:188712; TR-1991-1) Avail: NTIS HC/MF A07 CSCL 03B

The millimeter wave portion of the electromagnetic spectrum is critical for understanding the subcloud atmospheric structure of the Jovian planets (Jupiter, Saturn, Uranus, and Neptune). This research utilizes a combination of laboratory measurements, computer modeling, and radio astronomical observation in order to obtain a better understanding of the millimeter-wave spectra of the Jovian planets. The pressure broadened absorption from gaseous ammonia (NH3) and hydrogen sulfide (H2S) was measured in the laboratory under simulated conditions for the Jovian atmospheres. Researchers developed new formalisms for computing the absorptivity of gaseous NH3 and H2S based on their laboratory measurements. They developed a radiative transfer and thermochemical model to predict the abundance and distribution of absorbing constituents in the Jovian atmospheres. They used the model to compute the millimeter wave emission from the Jovian planets. Author

N91-31054# Office of Technology Assessment, Washington, DC.
EXPLORING THE MOON AND MARS: CHOICES FOR THE NATION
1991 117 p
(OTA-ISC-502) Avail: NTIS HC/MF A06; also available SOD HC $5.00 as 052-003-01250-2

This report assesses the potential for automation and robotics technology to assist in the exploration of the Moon and Mars, and raises a number of issues related to the goals of the U.S. civilian space program. These include the appropriate mix of humans and machines, timeliness, costs of space exploration, and the environmental, economic, and technological challenges of supporting a permanent base on the Moon and a manned mission to Mars. The report also discusses how greater attention to automation and robotics technologies could contribute to U.S. space exploration efforts. J.P.S.

N91-31055*# Arkansas Coll., Batesville.
VOLATILES IN INTERPLANETARY DUST PARTICLES Final Report
Roberta Bustin 1991 32 p
(Grant NAG9-522)
(NASA-CR-188731; NAS 1.26:188731) Avail: NTIS HC/MF A03 CSCL 03B

Interplanetary dust particles (IDP's) collected by specially equipped aircraft flying in the stratosphere have generated a lot of interest during the last decade. These particles, consisting of primitive materials originating in small solar system bodies such as comets and asteroids, are complex heterogeneous species with a variety of components. In order to understand the past histories of IDP's, it is particularly important to know the nature of the volatiles present. Volatiles released from a number of IDP's have been studied; however, a large number of particles must be studied in order to establish trends, to classify types of IDP's, and to have comparison data for determining the origins of IDP's. This study involves the analysis of six IDP's using laser microprobe mass spectrometry. Author

N91-31056*# Space Physics Research Inst., Sunnyvale, CA.
DIURNAL FORCING OF PLANETARY ATMOSPHERES Semiannual Status Report, 1 Jan. - 30 Jun. 1991
Howard C. Houben 30 Jun. 1991 44 p
(Contract NCC2-680)
(NASA-CR-188779; NAS 1.26:188779) Avail: NTIS HC/MF A03 CSCL 03B

The utility of the Mars Planetary Boundary Layer Model (MPBL) for calculations in support of the Mars 94 balloon mission was substantially enhanced by the introduction of a balloon equation of motion into the model. Both vertical and horizontal excursions of the balloon are calculated along with its volume, temperature, and pressure. The simulations reproduce the expected 5-min vertical oscillations of a constant density balloon at altitude on Mars. The results of these calculations are presented for the nominal target location of the balloon. A nonlinear balanced model was developed for the Martian atmosphere. It was used to initialize a primitive equation model for the simulations of the Earth's atmosphere at the time of the El Chichon eruption in 1982. It is also used as an assimilation model to update the temperature and wind fields at frequent intervals. Author

N91-31057*# Alabama Agricultural and Mechanical Coll., Normal.
MODEL OF JOVIAN F REGION IONOSPHERE (SATURNIAN IONOSPHERE IN OFFSET DIPOLE APPROXIMATION) Annual Report No. 3
A. Tan Jul. 1991 18 p
(Grant NAGw-1067)
(NASA-CR-188780; NAS 1.26:188780; AAMU-NAG-91-3) Avail: NTIS HC/MF A03 CSCL 03B

Researchers investigated the offset effect of Saturn's dipole on its ionosphere. The magnetic field of Saturn is primarily that of a dipole closely aligned to the rotational axis, but displaced northward from the center by a distance approximately equal to 0.05 R sub S, R sub S being the reference radius of Saturn. This offset effect would manifest itself most prominently between the ionospheric profiles in the Northern and Southern Hemispheres of Saturn. Author

N91-31058# Technische Univ., Berlin (Germany, F.R.). Inst. fuer Luft- und Raumfahrt.
LUNAR SPACEPORT: SPACE AIRPORT ON THE WORLD [LUNAR SPACEPORT: RAUMFLUGHAFEN AUF DEM MOND]
Andreas Eckert 1 Dec. 1990 49 p In GERMAN; ENGLISH

summary
(ILR-Mitt-250(1990); ETN-91-99459) Avail: NTIS HC/MF A03

Concepts for the manned development of the Moon include a launch and landing facility as a major component of the lunar surface infrastructure. This facility serves as a transfer point for all imported and exported goods of the lunar base. The function and possible concepts of a lunar spaceport are examined and described in a system analysis. Special importance was attached to the possibility of continuous extension of the facility to meet a fast growing traffic demand. A simulation program is presented, which is based on three different scenarios of lunar base development. This program illustrates the evolution of the lunar spaceport over an operational period of fifty years, beginning in 2005. Several aspects of planning and operation of particular lunar spaceport subsystems are discussed. ESA

92 SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots.

For related information see *93 Space Radiation*.

N91-31059# National Oceanic and Atmospheric Administration, Boulder, CO.
CATALOG OF SOLAR FILAMENT DISAPPEARANCES 1964-1980
C. S. Wright Feb. 1991 76 p Prepared in cooperation with Defence Science and Technology Organization, Salisbury (Australia) Sponsored in part by National Geophysical Data Center, Boulder, CO
(PB91-164384; UAG-100) Avail: NTIS HC/MF A05 CSCL 03B

Solar filaments are readily detected in H(alpha) observations of the Sun as either extended, dark features seen above the disk, or as bright prominences seen above the limb. They vary enormously in size. Filaments always lie above magnetic inversion lines, which separate regions of opposite magnetic polarity in the photosphere, although not all inversion lines are marked by visible filaments. Therefore, they enable the broad features of the large-scale magnetic fields at photospheric and chromospheric levels to be mapped from routine H(alpha) photographs. The primary motivation for compiling the catalogue was to examine the relationship between filament disappearances, interplanetary disturbances, and geomagnetic storms. Initially, the need was for a large, internally consistent list of events, and completeness was of secondary importance. The first tabulation fullfilled the purpose, but it was incomplete and did not provide a very satisfactory description of the filaments. The present catalogue is more complete, extends over a greater time-span and contains more information about each event. It is important to emphasize at this point that the filament disappearances tabulated in the catalogue are, in general, not associated with active regions or with flares within active regions. They predominantly lay over the quiet chromosphere and were generally much larger than active region filaments. Therefore, they should not be confused with the small, dark, inversion-line filaments which frequently erupt as part of the flare process within active regions. GRA

N91-31060*# Chicago Univ., IL.
SOLAR NEUTRINOS AND THE MSW EFFECT FOR THREE-NEUTRINO MIXING
X. Shi and David N. Schramm Jun. 1991 21 p Prepared in cooperation with Fermi National Accelerator Lab., Batavia, IL Submitted for publication
(Grant NAGw-1340)
(NASA-CR-188706; NAS 1.26:188706; FERMILAB-Pub-91/178-A) Avail: NTIS HC/MF A03 CSCL 03B

Researchers considered three-neutrino Mikheyev-Smirnov-Wolfenstein (MSW) mixing, assuming m sub 3 is much greater than m sub 2 is greater than m sub 1 as expected from theoretical consideration if neutrinos have mass. They calculated the corresponding mixing parameter space allowed by the Cl 37 and Kamiokande 2 experiments. They also calculated the expected depletion for the Ga-71 experiment. They explored a range of theoretical uncertainly due to possible astrophysical effects by varying the B-8 neutrino flux and redoing the MSW mixing calculation. Author

N91-31061*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
ANALYSES OF RISKS ASSOCIATED WITH RADIATION EXPOSURE FROM PAST MAJOR SOLAR PARTICLE EVENTS
Mark D. Weyland, William Atwell, Francis A. Cucinotta, John W. Wilson (National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.), and Alva C. Hardy Aug. 1991 37 p
(NASA-TP-3137; S-639; NAS 1.60:3137) Avail: NTIS HC/MF A03 CSCL 03B

Radiation exposures and cancer induction/mortality risks were investigated for several major solar particle events (SPE's). The SPE's included are: February 1956, November 1960, August 1972, October 1989, and the September, August, and October 1989 events combined. The three 1989 events were treated as one since all three could affect a single lunar or Mars mission. A baryon transport code was used to propagate particles through aluminum and tissue shield materials. A free space environment was utilized for all calculations. Results show the 30-day blood forming organs (BFO) limit of 25 rem was surpassed by all five events using 10 g/sq cm of shielding. The BFO limit is based on a depth dose of 5 cm of tissue, while a more detailed shield distribution of the BFO's was utilized. A comparison between the 5 cm depth dose and the dose found using the BFO shield distribution shows that the 5 cm depth value slightly higher than the BFO dose. The annual limit of 50 rem was exceeded by the August 1972, October 1989, and the three combined 1989 events with 5 g/sq cm of shielding. Cancer mortality risks ranged from 1.5 to 17 percent at 1 g/sq cm and 0.5 to 1.1 percent behind 10 g/sq cm of shielding for five events. These ranges correspond to those for a 45 year old male. It is shown that secondary particles comprise about 1/3 of the total risk at 10 g/sq cm of shielding. Utilizing a computerized Space Shuttle shielding model to represent a typical spacecraft configuration in free space at the August 1972 SPE, average crew doses exceeded the BFO dose limit. Author

N91-31062# National Geophysical Data Center, Boulder, CO.
SOLAR-GEOPHYSICAL DATA NUMBER 559, MARCH 1991. PART 1: (PROMPT REPORTS). DATA FOR FEBRUARY, JANUARY 1991 AND LATE DATA
Feb. 1991 154 p
(PB91-190611; SGD-559-Pt-1) Avail: NTIS HC/MF A08 CSCL 03B

Solar-geophysical data are presented. The following subject areas are covered: (1) detailed index for 1990 to 1991; (2) data for February 1991 (solar-terrestrial environment, IUWDS advance and worldwide alert periods, solar activity indices, solar flares, solar radio emission, and Stanford mean solar magnetic field); and (3) data for January 1991 (solar active regions, sudden ionospheric disturbances, solar radio spectral observations, cosmic ray measurement by neutron monitor, and geomagnetic indices). Author

N91-31063# National Geophysical Data Center, Boulder, CO.
SOLAR-GEOPHYSICAL DATA NUMBER 559, MARCH 1991. PART 2: (COMPREHENSIVE REPORTS). DATA FOR SEPTEMBER 1990 AND MISCELLANEOUS
Sep. 1990 74 p
(PB91-190629; SGD-559-Pt-2) Avail: NTIS HC/MF A04 CSCL 03B

A detailed index is presented for 1990 to 1991. Data is presented for September 1990: solar flares, solar radio bursts at fixed frequencies; interplanetary solar particles and plasma, solar x ray radiation from GOES satellite, mass ejections from the Sun, active prominences and filaments. GRA

N91-31064# National Oceanic and Atmospheric Administration, Boulder, CO. Environment Research Labs.
SOLAR-TERRESTRIAL PREDICTIONS. PROCEEDINGS OF A WORKSHOP. VOLUME 1: WORKING GROUP REPORTS, REVIEW PAPERS AND SOLAR PAPERS
R. J. Thompson, D. G. Cole, P. J. Wilkinson, M. A. Shea, and D. Smart Nov. 1990 713 p Workshop held in Leura, Australia, 16-20 Oct. 1989
(PB91-197079) Avail: NTIS HC/MF A99 CSCL 03B

The following subject areas are covered: the magnetosphere environment; forecasting magnetically quiet periods; radiation hazards to human in deep space (a summary with special reference to large solar particle events); solar proton events (review and status); problems of the physics of solar-terrestrial interactions; prediction of solar proton fluxes from x-ray signatures; rhythms in solar activity and the prediction of episodes of large flares; the role of persistence in the 24-hour flare forecast; on the relationship between the observed sunspot number and the number of solar flares; the latitudinal distribution of coronal holes and geomagnetic storms due to coronal holes; and the signatures of flares in the interplanetary medium at 1 AU. Author

N91-31065# National Oceanic and Atmospheric Administration, Boulder, CO. Environmental Research Labs.
SOLAR-TERRESTRIAL PREDICTIONS: PROCEEDINGS OF A WORKSHOP. VOLUME 2: GEOMAGNETIC AND SPACE ENVIRONMENT PAPERS AND IONOSPHERE PAPERS
R. J. Thompson, D. G. Cole, P. J. Wilkinson, M. A. Shea, and D. Smart Nov. 1990 439 p Workshop held in Leura, Australia, 16-20 Oct. 1989 Prepared in cooperation with Air Force Geophysics Lab., Hanscom AFB, MA; and IPS Radio and Space Services, Chatswood (Australia)
(PB91-197087) Avail: NTIS HC/MF A19 CSCL 03B

The following subject areas were covered: a probability forecast for geomagnetic activity; cost recovery in solar-terrestrial predictions; magnetospheric specification and forecasting models; a geomagnetic forecast and monitoring system for power system operation; some aspects of predicting magnetospheric storms; some similarities in ionospheric disturbance characteristics in equatorial, mid-latitude, and sub-auroral regions; ionospheric support for low-VHF radio transmission; a new approach to prediction of ionospheric storms; a comparison of the total electron content of the ionosphere around L=4 at low sunspot numbers with the IRI model; the French ionospheric radio propagation predictions; behavior of the F2 layer at mid-latitudes; and the design of modern ionosondes. Author

N91-31066# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
SOLAR ILLUMINATION GEOMETRY AND ITS INFLUENCE ON THE OBSERVANCE OF GEOLOGICAL STRUCTURES IN ORBITAL IMAGERY [A GEOMETRIA DA ILUMINACAO SOLAR E SUA INFLUENCIA NA OBSERVACAO DE ESTRUTURAS GEOLOGICAS EM IMAGENS ORBITAIS]
Jose Eduardo Rodrigues and Chan Chiang Liu Apr. 1991 9 p In PORTUGUESE; ENGLISH summary Presented at the 4th Brazilian Symposium for Remote Sensing, Natal, Brazil, Oct. 1988
(INPE-3424-PRE/687) Avail: NTIS HC/MF A02

The geology of the westernmost part of Rio de Janeiro State (Brazil) is characterized by the conspicuous presence of the Alem Paraiba lineament, a large shear zone extending more than 200 km in N50-60E direction. Parts of Paraiba do Sul river and of the regional topography are strongly related to this geologic feature. Several other lineament directions complete the structural framework that can be seen on remote sensing products. According to well accepted theories of photointerpretation, LANDSAT images with low sun elevation angles should more clearly show those lineaments, because the shadow enhancement of the relief is greatest. Also, considering the high grade of relief conditionment by the Alem Paraiba lineament, it is expected that this structure could be clearly observed on LANDSAT images of all seasons. However, these hypotheses are not confirmed. The images with low sun elevation angles belong to the epoch (winter) in which the solar azimuths are nearly parallel to the regional structure, making its identification difficult. In summer, the images have high sun elevation angles but their solar azimuths, oblique to the regional structures, allow an adequate identification of the main structural trend. Author

93 SPACE RADIATION

Includes cosmic radiation; and inner and outer earth's radiation belts.

For biological effects of radiation see *52 Aerospace Medicine*. For theory see *73 Nuclear and High-Energy Physics*.

N91-31067*# Fermi National Accelerator Lab., Batavia, IL.
NON-GAUSSIAN MICROWAVE BACKGROUND FLUCTUATIONS FROM NONLINEAR GRAVITATIONAL EFFECTS
D. S. Salopek and G. Kunstatter, ed. Jun. 1991 9 p Presented at the 4th Canadian Conference on General Relativity and Relativistic Astrophysics, Winnipeg, Manitoba, 16-18 May 1991
(Grant NAGw-1346)
(NASA-CR-188699; NAS 1.26:188699; FERMILAB-Pub-91/161-A) Avail: NTIS HC/MF A02 CSCL 03B

Whether the statistics of primordial fluctuations for structure formation are Gaussian or otherwise may be determined if the Cosmic Background Explorer (COBE) Satellite makes a detection of the cosmic microwave-background temperature anisotropy delta T(sub CMB)/T(sub CMB). Non-Gaussian fluctuations may be generated in the chaotic inflationary model if two scalar fields interact nonlinearly with gravity. Theoretical contour maps are calculated for the resulting Sachs-Wolfe temperature fluctuations at large angular scales (greater than 3 degrees). In the long-wavelength approximation, one can confidently determine the nonlinear evolution of quantum noise with gravity during the inflationary epoch because: (1) different spatial points are no longer in causal contact; and (2) quantum gravity corrections are typically small-- it is sufficient to model the system using classical random fields. If the potential for two scalar fields V(phi sub 1, phi sub 2) possesses a sharp feature, then non-Gaussian fluctuations may arise. An explicit model is given where cold spots in delta T(sub CMB)/T(sub CMB) maps are suppressed as compared to the Gaussian case. The fluctuations are essentially scale-invariant. Author

N91-31068*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
CATALOG OF SAS-2 GAMMA-RAY OBSERVATIONS (FICHTEL, ET AL. 1990)
Wayne H. Warren, Jr. Jul. 1990 21 p
(NASA-TM-105053; NSSDC/WDC-A-R/S-90-20; NAS 1.15:105053) Avail: NTIS HC/MF A03 CSCL 03B

The machine-readable version of the catalog, as it is currently being distributed from the Astronomical Data Center, is described. The SAS-2 gamma ray catalog contains fluxes measured with the high energy gamma ray telescope flown aboard the second NASA Small Astronomy Satellite. The objects measured include various types of galaxies, quasi-stellar, and BL Lacertae objects, and pulsars. The catalog contains separate files for galaxies, pulsars, other objects, notes, and references. Author

N91-31069*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
THE HEAO A-1 X RAY SOURCE CATALOG (WOOD ET AL. 1984): DOCUMENTATION FOR THE MACHINE-READABLE VERSION
Wayne H. Warren, Jr. Jul. 1990 16 p Original contains color illustrations
(NASA-TM-105051; NSSDC/WDC-A-R/S-90-18; NAS 1.15:105051) Avail: NTIS HC/MF A03; 1 functional color page CSCL 03B

The machine-readable version of the catalog, as it is currently

being distributed from the Astronomical Data Center, is described. The catalog is a compilation of data for 842 sources detected with the U.S. Naval Research Laboratory Large Area Sky Survey Experiment flown aboard the HEAO 1 satellite. The data include source identifications, positions, error boxes, mean X-ray intensities, and cross identifications to other source designations. Author

N91-31070*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
A CATALOG OF SELECTED COMPACT RADIO SOURCES FOR THE CONSTRUCTION OF AN EXTRAGALACTIC RADIO/OPTICAL REFERENCE FRAME (ARGUE ET AL. 1984): DOCUMENTATION FOR THE MACHINE-READABLE VERSION
Oct. 1990 15 p
(NASA-TM-105056; NAS 1.15:105056; NSSDC/WDC-A-R/S-90-25) Avail: NTIS HC/MF A03 CSCL 03B

This document describes the machine readable version of the Selected Compact Radio Source Catalog as it is currently being distributed from the international network of astronomical data centers. It is intended to enable users to read and process the computerized catalog. The catalog contains 233 strong, compact extragalactic radio sources having identified optical counterparts. The machine version contains the same data as the published catalog and includes source identifications, equatorial positions at J2000.0 and their mean errors, object classifications, visual magnitudes, redshift, 5-GHz flux densities, and comments. Author

N91-31071# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
SPECTRUM VARIABILITY STUDY OF RADIO SOURCES IN THE 22 TO 43 GHz RANGE Ph.D. Thesis [ESTUDO DA VARIABILIDADE E DO ESPECTRO DE RADIOFONTES EM 22 E 43 GHZ]
Luiz Claudio Lima Botti Dec. 1990 266 p In PORTUGUESE; ENGLISH summary
(INPE-5218-TDL/432) Avail: NTIS HC/MF A12

Researchers have observed several quasars, BL Lac objects and other sources like Cen A, Sgr A at 22 GHz and 43 GHz for ten years. The principal goal of this work is the study of the temporal and spectral variability of these objects. The researchers applied the shock wave model (Marscher and Gear, 1985) and the canonical model (Van der Laan, 1966: Pauliny-Toth, 1966; Jones, O'Dell and Stein, 1974). The researchers calculated the very long baseline interferometry (VBLI) position of the knots, the magnetic field intensity, and angular dimension of the sources. Simultaneous observations were made with the Swedish-ESO submillimeter telescope at 22, 43, 90 and 230 GHz. Simultaneous spectra are shown. Author

N91-31072# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
CONTINUOUS MILLIMETER RADIATION DIAGNOSTICS OF THE CARINA NEBULA, CTB-33 AND THE GALACTIC CENTER Ph.D. Thesis [DIAGNOSTICO NO CONTINUO MILIMETRICO DAS REGIOES GALACTICAS CARINA, CTB33 E CENTRO GALACTICO]
C. C. Tateyama Dec. 1990 150 p In PORTUGUESE; ENGLISH summary
(INPE-5221-TDL/435) Avail: NTIS HC/MF A07

The HII regions and supernova remnants are objects of vast astrophysical interest not only considering their own characteristics, but also due to their interaction with the interstellar medium. The physical conditions of the sources based on structural informations contained in radio maps at high frequencies (22 and 43 GHz) were studied. For this purpose, the work was conducted making a diagnostic of the morphology present in the maps of three regions of special interest in the galactic plane, namely: the regions of the Carina nebula, CTB-33 and the Galactic Center. The discussion of the nature of the sources includes measurements of the spectral index, comparing data with maps obtained at lower frequencies and similar angular resolution. Author

N91-31073# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
INTRODUCTION TO THE STUDY OF COSMIC RAYS AND THEIR INTERACTION WITH THE TERRESTRIAL ATMOSPHERE [INTRODUCAO AO ESTUDO DOS RAIOS COSMICOS E SUA INTERACAO COM A ATMOSFERA TERRESTRE]
Luiz Alexandre Schuch 1991 120 p In PORTUGUESE; ENGLISH summary
(INPE-5243-RPQ/649) Avail: NTIS HC/MF A06

A broad survey is presented on the origin and composition of cosmic rays, its modulation associated with solar activity, its interaction with the Earth's magnetic field and atmosphere and its energy spectrum at sea level. Special attention is given to detection systems and to the effects of cosmic rays on material and live beings, especially man. Author

N91-31074# Rutherford High Energy Lab., Chilton (England).
SUPERNOVA DETECTORS BASED ON COHERENT NUCLEAR RECOIL
P. F. Smith and J. D. Lewin Mar. 1991 11 p Presented at Supernova Workshop, Santa Monica, CA, 27-28 Nov. 1990
(RAL-91-016; ETN-91-99555) Avail: NTIS HC/MF A03

A speculative idea, that of using coherent nuclear recoil from elastic neutrino scattering as a detector sensitive to supernovas at distances greater than 1 Mpc is considered. A comparison with alternative detectors, primarily the chalk detector, is made. The coherent rates from supernova burst, and the background rate for chalk and coherent detector are discussed. Problems of these detectors are considered and directions for further development are given. ESA

99 GENERAL

N91-31075*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
THE 1990 ANNUAL STATISTICS AND HIGHLIGHTS REPORT
James L. Green Mar. 1991 52 p
(NASA-TM-105042; NAS 1.15:105042; NSSDC/WDC-A-R/S-91-14) Avail: NTIS HC/MF A04 CSCL 05B

The National Space Science Data Center (NSSDC) has archived over 6 terabytes of space and Earth science data accumulated over nearly 25 years. It now expects these holdings to nearly double every two years. The science user community needs rapid access to this archival data and information about data. The NSSDC has been set on course to provide just that. Five years ago the NSSDC came on line, becoming easily reachable for thousands of scientists around the world through electronic networks it managed and other international electronic networks to which it connected. Since that time, the data center has developed and implemented over 15 interactive systems, operational nearly 24 hours per day, and is reachable through DECnet, TCP/IP, X25, and BITnet communication protocols. The NSSDC is a clearinghouse for the science user to find data needed through the Master Directory system whether it is at the NSSDC or deposited in over 50 other archives and data management facilities around the world. Over 13,000 users accessed the NSSDC electronic systems, during the past year. Thousands of requests for data have been satisfied, resulting in the NSSDC's sending out a volume of data last year that nearly exceeded a quarter of its holdings. This document reports on some of the highlights and distribution statistics for most of the basic NSSDC operational services for fiscal year 1990. It is intended to be the first of a series of annual reports on how well NSSDC is doing in supporting the space and Earth science user communities. J.P.S.

N91-31076*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
RESEARCH AND TECHNOLOGY Annual Report, 1990

Mar. 1991 284 p
(NASA-TM-102172; S-620; NAS 1.15:102172) Avail: NTIS HC/MF A13 CSCL 05A

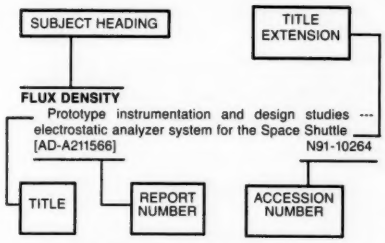
Significant research and technology activities at the Johnson Space Center (JSC) during Fiscal Year 1990 are reviewed. Research in human factors engineering, the Space Shuttle, the Space Station Freedom, space exploration and related topics are covered. Author

N91-31077# National Inst. of Standards and Technology, Gaithersburg, MD.
JOURNAL OF RESEARCH OF THE NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY, JANUARY-FEBRUARY 1991, VOLUME 96, NUMBER 1
Barry N. Taylor, ed. 1991 150 p
(PB91-184853) Avail: NTIS HC/MF A07; also available SOD HC $3.75 as 703-027-000-38-5 CSCL 05A

The following subject areas are covered: new chemical and stereochemical applications of organoiron complexes; international conference on the chemistry of electronic ceramic materials; news briefs; calibration services; and standard reference data. GRA

N91-30174# Joint Publications Research Service, Arlington, VA.
GALEYEV DISCUSSES HISTORY, PROSPECTS OF INSTITUTE OF SPACE RESEARCH
Albrrt Abubakirovich Galeyev *In its* JPRS Report: Science and Technology. USSR: Space 26 Jun. 1991 p 34-39 Transl. into ENGLISH from Zemlya i Vselennaya, Moscow (USSR), Nov.-Dec. 1990 p 38-45 (For primary document see N91-30170 22-12)
Avail: NTIS HC/MF A04

Typical Subject Index Listing



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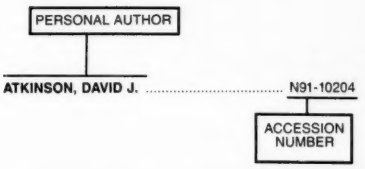

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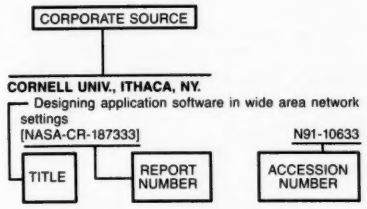

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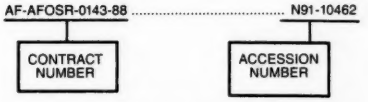

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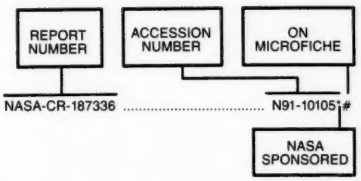

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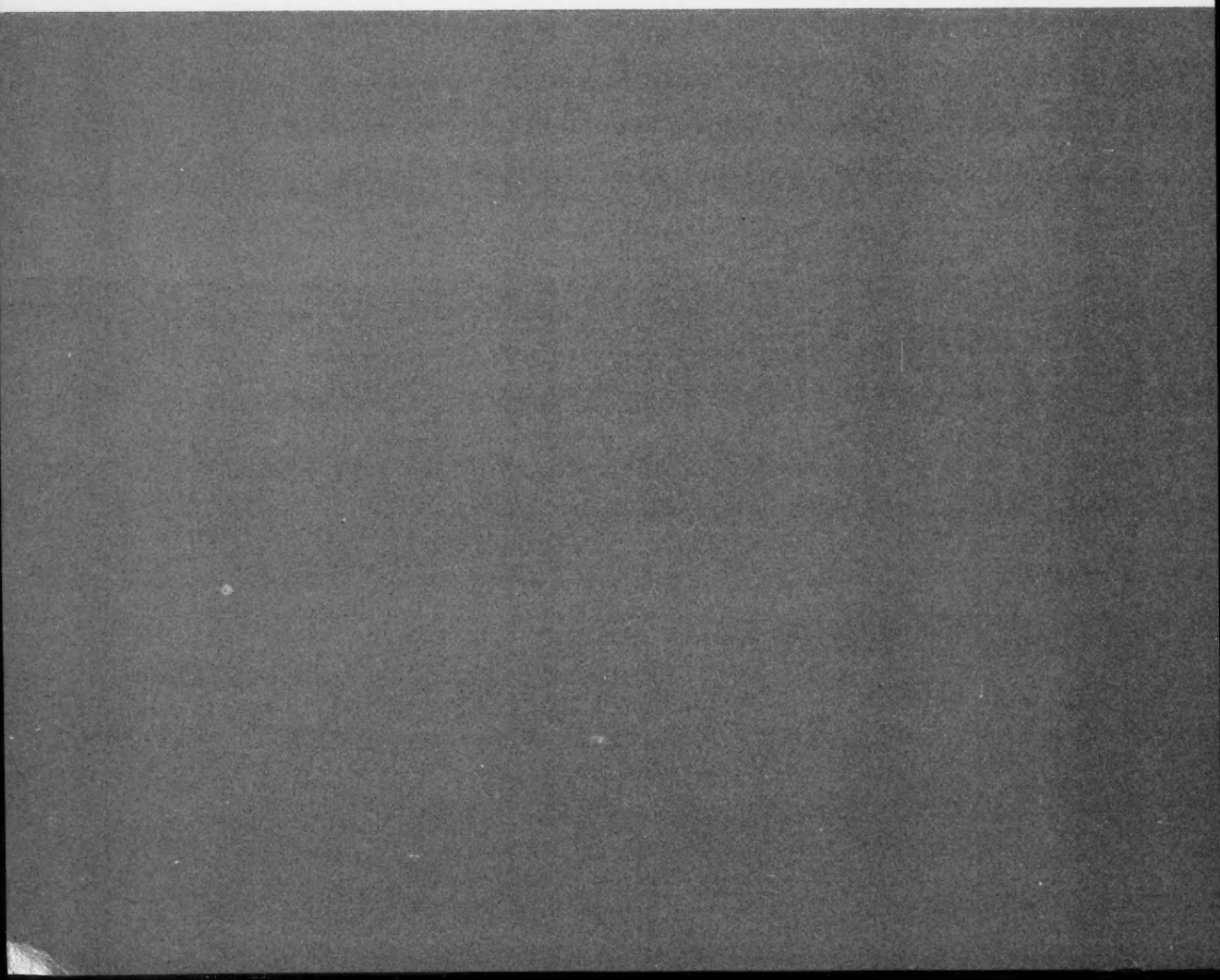
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